ANNALS OF SURGERY

VOL. XLII SEPTEMBER, 1905 No. 3

ORIGINAL MEMOIRS.

DRY IODINE CATGUT.[1]

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ABOUT one year ago I presented to the Surgical Section of the New York Academy of Medicine a brief report[1] on Claudius's catgut, in which I pointed out its advantages over catgut prepared by other methods. This method of preparation was soon adopted by surgeons in various parts of the country, and it was not long before I received various complaints concerning its tensile strength; and it is but proper to confess that, though we continued to use it, we also found that this complaint was not entirely without foundation. Its other advantages were, however, so preponderating, that, though not satisfactory in all details, we were loath to abandon it entirely, and I therefore set myself the task to find, and if possible to eliminate, the causes of this loss of strength. I soon became convinced that this was due only to its long-continued immersion in the iodine solution. In other words, no change was necessary in the preparation of the catgut, but one was indi-

[1] Read before the Surgical Section of the New York Academy of Medicine, May 5, 1905.

cated in its subsequent preservation. According to Claudius's directions, the catgut was preserved in the original iodine solution for an indefinite time. I have changed these directions in so far that I remove the catgut from the iodine solution at the end of eight days, and thereafter keep it dry and ready for use in a sterile vessel. This step, however, be it ever so simple, involved to my mind a material departure from Claudius's method, and it was necessary therefore to again subject the dry catgut to an investigation of the attributes required of good catgut; and it is the object of this paper to present the results of my research.

As I pointed out in my original article, the four cardinal attributes which must be present in an ideal catgut are, (1) It should be absolutely sterile; (2) in the course of preparation it should not lose any of its tensile strength; (3) it should be readily and simply prepared, and without any undue expense, and (4) it should be absorbed completely, but only after it has served the purposes for which it was intended.

1. STERILITY.—Dr. Arpad G. Gerster and myself have used in the First Surgical Division of Mount Sinai Hospital as a routine procedure catgut prepared by means of iodine solution for nearly three years; during the past nine months after the modified method; and in no case have we had the slightest occasion for regretting our confidence in it. What is of practical interest at the present time is our experience with the newer catgut, and I can only say, that during the time mentioned we have used it in every instance where the use of catgut was indicated, not only as ligature, but also as suture material, and at no time did we see any untoward effects from it.

As already stated, the method now in use is to my mind an important departure from the original method of Claudius. Sufficient evidence for the sterility of catgut prepared by the Claudius method was presented by Claudius,[2], [3] Martina,[4] von Hippel,[5] and Johnson;[6] but it was necessary to examine the newer catgut also from a bacteriological stand-point. A few preliminary experiments were made for me by Dr. Alfred Cohn, of the house staff of Mount Sinai Hospital; the detailed

experiments I was able to conduct at the Pathological Laboratory of the College of Physicians and Surgeons, Columbia University, through the courtesy of Dr. T. Mitchell Prudden; and I take great pleasure on this occasion to express my gratitude to Dr. Prudden, not only for the many courtesies extended, but also for his valuable advice and for the interest shown in my work.

At the outset, I would state that all of the experiments were conducted with No. 1 iodine catgut, and that all of the experiments were controlled with catgut of similar size, prepared after the von Bergmann method.

The various experiments conducted may be conveniently grouped under the following headings:

A. *Tests to prove the sterility of the catgut.*

B. *Tests to show the effect of catgut on growing cultures.*

C. *Tests to show the effect of infected catgut.*

A. *Tests to prove the Sterility of the Catgut.*—These experiments were conducted in the following manner. Pieces of iodine catgut and of von Bergmann catgut, about one inch in length, were placed in the following media: Bouillon, gelatin (previously liquefied and poured into a Petri dish), agar-agar (previously liquefied and poured into a Petri dish), and serum-bouillon; the gelatin plates were kept at room-temperature, the remainder in the thermostat, and all were observed from day to day for about two weeks.

Following is an account of these experiments:

EXPERIMENT 1.—December 30. Iodine gut planted into bouillon. December 31, no growth. January 1, no growth. Observations taken until January 14, up to which date there was not the slightest clouding of the medium noted.

EXPERIMENT 2.—December 30. Von Bergmann catgut planted into bouillon. December 31, no growth. January 2, growth, as shown by cloudiness of the medium. Observations taken until January 14, but no further change noted.

EXPERIMENT 3.—December 30. Gelatin was liquefied and poured into a Petri dish; after solidification, a piece of iodine gut was placed upon it. December 31, no growth, nor at any time until January 7, when further observation was discontinued.

EXPERIMENT 4.—December 30. Gelatin was liquefied and poured into

a Petri dish; after solidification, a piece of von Bergmann catgut was placed upon it. December 31, no growth. January 2, no growth. January 3, one colony at great distance from the catgut. (Accidental contamination.) Observations taken until January 7, but no further change noted.

EXPERIMENT 5.—Agar-agar was liquefied and poured into a Petri dish; after solidification, a piece of iodine gut was placed upon it. December 31, no growth. January 2, no growth, nor at any time until January 10, when further observation was discontinued.

EXPERIMENT 6.—December 30. Agar-agar was liquefied and poured into a Petri dish; after solidification, a piece of von Bergmann catgut was placed upon it. December 31, no growth. January 2, no growth, nor at any time until January 10, when further observation was discontinued.

EXPERIMENT 7.—December 30. Equal parts of hydrocele-serum and bouillon were mixed, and into this mixture a piece of iodine gut was placed. December 31, no growth, nor at any time until January 14, when further observation was discontinued.

EXPERIMENT 8.—December 30. Equal parts of hydrocele-serum and bouillon were mixed in a test-tube, and into this mixture a piece of von Bergmann catgut was placed. December 31, no growth. Observations taken until January 10, when the medium became turbid, and remained so until January 14, when further observations were discontinued.

EXPERIMENT 9.—December 31. Repetition of Experiment 1; remained sterile until January 14, when further observation was discontinued.

EXPERIMENT 10.—December 31. Repetition of Experiment 2. January 2, no growth. January 3, medium turbid. Observations taken until January 14, but no further change noted.

EXPERIMENT 11.—December 31. Repetition of Experiment 3; remained sterile until January 10, when further observation was discontinued.

EXPERIMENT 12.—December 31. Repetition of Experiment 4. January 2, growth beginning at one end of the catgut, and therefore might be looked upon as a contamination. January 3, the entire plate was overgrown. Observations continued until January 7, but no further change noted.

EXPERIMENT 13.—December 31. Repetition of Experiment 5; remained sterile until January 10, when further observation was discontinued.

EXPERIMENT 14.—December 31. Repetition of Experiment 6; remained sterile until January 10, when further observation was discontinued.

EXPERIMENT 15.—December 31. Repetition of Experiment 7; remained sterile until January 14, when further observation was discontinued.

EXPERIMENT 16.—December 31. Repetition of Experiment 8; re-

mained sterile until January 14, when further observation was discontinued.

It might be argued by some that the iodine catgut, owing to its imbibition with iodine, is so powerful that in a measure it sterilizes the comparatively small amount of bouillon in a test-tube; to refute this argument, I have a number of times repeated the above experiments with iodine gut, but used for each experiment a much larger quantity (60 cubic centimetres) of bouillon, but in no instance did I obtain a growth.

In summing up these sixteen experiments, it is at once evident that all the tests made with the iodine gut remained sterile; some of the tests made with the von Bergmann catgut showed a growth, notably those made with bouillon (Experiments 2 and 10). The von Bergmann catgut is not on trial here, but in view of these tests it certainly shows an inferiority. Suffice it to say that these experiments justify at least the positive conclusion that the iodine catgut is sterile.

B. *Tests to show the Effect of the Catgut on growing Cultures.*

EXPERIMENT 52.—January 10. A tube of agar-agar was liquefied, infected with Bacterium coli, and poured into a Petri dish. After solidification, a piece of iodine catgut was placed upon it. January 11, numberless colonies developed, but none in a space three-quarters of an inch wide surrounding the catgut. January 12, the only change noted was an increase in the size of some of the colonies at the margin of the clear space. Observations taken until January 16, but no further change noted. (See illustration.)*

EXPERIMENT 53.—January 10. A tube of agar-agar was liquefied, infected with Bacterium coli, and poured into a Petri dish. After solidification, a piece of von Bergmann catgut was placed upon it. January 11, growth everywhere upon the plate, except in a space about three-sixteenths of an inch in width surrounding the catgut. Observations taken until January 16, but no further change noted. (See illustration.)

EXPERIMENT 54.—January 10. A tube of agar-agar was liquefied, infected with Staphylococcus aureus, and poured into a Petri dish. After solidification, a piece of iodine gut was placed upon it. January 11, numberless colonies upon the plate, except in a space about two inches wide surrounding the catgut. Observations taken until January 16, but no

* Dr. Edward Leaming was kind enough to make for me the photographs accompanying this article, for which I wish to express my thanks also on this occasion.

material change noted, excepting an increase in the size of the colonies near the margin of the clear space. (See illustration.)

EXPERIMENT 55.—January 10. A tube of agar-agar was liquefied, infected with Staphylococcus aureus, and poured into a Petri dish. After solidification, a piece of von Bergmann catgut was placed upon it. January 11, numberless colonies everywhere, excepting in a space about one-eighth of an inch in width surrounding the catgut. Observations taken until January 16, but no further change noted. (See illustration.)

EXPERIMENT 60.—January 10. A tube of gelatin was liquefied, infected with Bacterium coli, and poured into a Petri dish. After solidification, a piece of iodine gut was placed upon it. January 11, no growth. January 12, numerous colonies, excepting in a space about two inches wide surrounding the catgut. Observation continued until January 16, but no further change noted.

EXPERIMENT 61.—January 10. A tube of gelatin was liquefied, infected with Bacterium coli, and poured into a Petri dish. After solidification, a piece of von Bergmann catgut was placed upon it. January 11, numberless colonies everywhere, excepting in a space about one-quarter of an inch wide surrounding the catgut, and even here a few isolated colonies are to be seen with the microscope. Observations taken until January 16, but no further change noted except an increase in the size of some of the colonies.

EXPERIMENT 62.—January 10. A tube of gelatin was liquefied, infected with Staphylococcus aureus, and poured into a Petri dish. After solidification, a piece of iodine catgut was placed upon it. January 11, no growth. January 12, numerous colonies, excepting a space about two inches wide surrounding the catgut. Observations taken until January 16, but no further change noted.

EXPERIMENT 63.—January 10. A tube of gelatin was liquefied, infected with Staphylococcus aureus, and poured into a Petri dish. After solidification, a piece of von Bergmann catgut was placed upon it. January 11, no growth. January 12, numerous colonies, except in a space about one-quarter of an inch in width surrounding the catgut. January 13, colonies almost up to the catgut. Observations taken until January 16, but no further change noted.

EXPERIMENT 111.—January 16. A tube of agar-agar was liquefied, infected with Bacillus anthracis, and poured into a Petri dish. After solidification, a piece of iodine gut was placed upon it. January 17, numerous colonies, but none within two and one-quarter inches of the catgut. January 18, a large number of isolated colonies developed within the space previously clear, but none within a space of one inch surrounding the catgut. Observations taken until January 21, but no further change noted. (See illustration.)

EXPERIMENT 112.—January 16. A tube of agar-agar was liquefied, infected with Bacillus anthracis, and poured into a Petri dish. After solidification, a piece of von Bergmann catgut was placed upon it. January 17, numerous colonies, excepting in a space about one-half inch wide,

No. 52. Agar infected with Bacillus coli, with iodine gut on top.
No. 53. Agar infected with Bacillus coli, with von Bergmann gut on top.

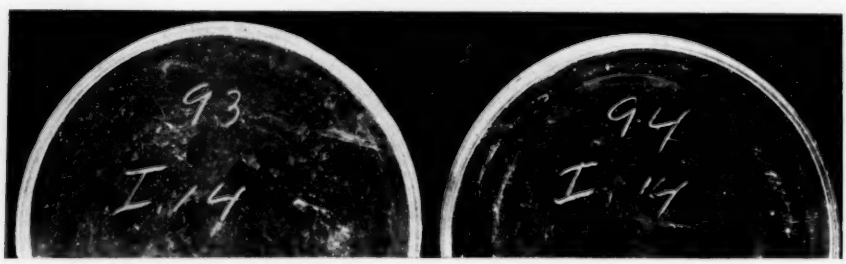
No. 54. Agar infected with Staphylococcus aureus, with iodine gut on top.
No. 55. Agar infected with Staphylococcus aureus, with von Bergmann gut on top.

No. 111. Agar infected with Bacillus anthracis, with iodine gut on top.
No. 112. Agar infected with Bacillus anthracis, with von Bergmann gut on top.

No. 56. Smears of Bacillus coli on agar, with iodine gut on top.
No. 57. Smears of Bacillus coli on agar, with von Bergmann gut on top.

No. 58. Smears of Staphylococcus aureus on agar, with iodine gut on top.
No. 59. Smears of Staphylococcus aureus on agar, with von Bergmann gut on top.

No. 68. Smears of Staphylococcus aureus on agar, with iodine gut on top.
No. 69. Smears of Staphylococcus aureus on agar, with von Bergmann gut on top.



No. 93. Smears of Bacillus anthracis on agar, with iodine gut on top.
No. 94. Smears of Bacillus subtilis on agar, with von Bergmann gut on top.

No. 95. Smears of Bacillus subtilis on agar, with iodine gut on top.
No. 96. Smears of Bacillus subtilis on agar, with von Bergmann gut on top.

surrounding the catgut. Observations taken until January 21, but only a slight extension of the colonies noted. (See illustration.)

EXPERIMENT 113.—January 16. A tube of agar-agar was liquefied, infected with Bacillus anthracis, and poured into a Petri dish. After solidification, a piece of iodine catgut was placed upon it. January 17, numerous colonies, but none within one and three-quarters inches of the catgut. January 18, a few scattered colonies around the margin of the space previously clear, but still there are no colonies within one inch of the catgut. Observations taken until January 21, but no further change noted, excepting an increase in the size of some of the superficial colonies.

EXPERIMENT 114.—January 16. A tube of agar-agar was liquefied, infected with Bacillus subtilis, and poured into a Petri dish. After solidification, a piece of von Bergmann catgut was placed upon it. January 17, numerous colonies, but none within a space, about one-third of an inch wide, surrounding the catgut. Observations taken until January 21, but no further change noted.

EXPERIMENT 91.—January 14. A tube of agar-agar was liquefied, infected with Streptococcus pyogenes, and poured into a Petri dish. After solidification, a piece of iodine catgut was placed upon it. January 15, a few colonies to be seen with the microscope, but only at the margins of the Petri dish. Observations taken until January 21, but no further change noted.

EXPERIMENT 92.—January 14. A tube of agar-agar was liquefied, infected with Streptococcus pyogenes, and poured into a Petri dish. After solidification, a piece of von Bergmann catgut was placed upon it. January 15, numerous colonies to be seen with the naked eye and microscope, but none in a space about one-half inch wide surrounding the catgut. Observations taken until January 21, but no further change noted.

EXPERIMENT 56.—January 10. Smears of Bacterium coli were made upon agar solidified in a Petri dish; upon these a piece of iodine gut was placed. January 11, numerous colonies, but none anywhere near the catgut. January 12, the colonies are larger than on January 11, but there is no extension towards the catgut. Observations taken until January 16, but no further change noted. (See illustration.)

EXPERIMENT 57.—January 10. Smears of Bacterium coli were made upon agar solidified in a Petri dish; upon these a piece of von Bergmann catgut was placed. January 11, growth on all smears almost up to the catgut, though not quite in contact with it. Observations taken until January 16, but only an increase in the size of the colonies noted. (See illustration.)

EXPERIMENT 58.—January 10. Smears of Staphylococcus aureus were made upon agar solidified in a Petri dish; upon these a piece of iodine gut was placed. January 11, growth on all smears distant from the catgut, but none anywhere near it. Observations taken until January 16, but only an increase in the size of the colonies noted. (See illustration.)

EXPERIMENT 59.—January 10. Smears of Staphylococcus aureus were made upon agar solidified in a Petri dish; upon these a piece of von

Bergmann catgut was placed. January 11, growth on all smears, almost up to the catgut, but not quite in contact with it. January 12, increase in the size of the colonies, and their extension towards the catgut was noted, so as to be almost in contact with it. Observations taken until January 16, but only an increase in the size of the colonies noted. (See illustration.)

EXPERIMENT 66.—January 11 is a repetition of Experiment 56, and is inserted here merely on account of the perfect illustration, which see.

EXPERIMENT 67.—January 11 is a repetition of Experiment 57, and is inserted here merely on account of the perfect illustration, which see.

EXPERIMENT 68.—January 11 is a repetition of Experiment 58, and is inserted here merely on account of the perfect illustration, which see.

EXPERIMENT 69. January 11 is a repetition of Experiment 59, and is inserted here merely on account of the perfect illustration, which see.

EXPERIMENT 93.—January 14. Smears of Bacillus anthracis were made upon agar solidified in a Petri dish; upon these a piece of iodine gut was placed. January 15, a few colonies developed near the ends of the streaks, but none anywhere near the catgut. Observations taken until January 21, but no further change noted. (See illustration. The colonies to the left of the catgut in this illustration are not of anthrax, but are accidental contaminations, developing sometime after the experiment.)

EXPERIMENT 94.—January 14. Smears of Bacillus anthracis were made upon agar solidified in a Petri dish; upon these a piece of von Bergmann catgut was placed. January 15, abundant growth on all streaks up to one-quarter of an inch from the catgut. Observations taken until January 21, but only an increase in the size of the colonies noted. (See illustration.)

EXPERIMENT 95.—January 14. Smears of Bacillus subtilis were made upon agar solidified in a Petri dish; upon these a piece of iodine gut was placed. January 15, growth at both ends of the streaks, but none anywhere near the catgut. Observations taken until January 21, but no further change noted. (See illustration.)

EXPERIMENT 96.—January 14. Smears of Bacillus subtilis were made upon agar solidified in a Petri dish; upon these a piece of von Bergmann catgut was placed. January 15, plate overgrown with extensive colonies in actual contact with the catgut. Observations taken until January 21, but no further change noted. (See illustration.)

EXPERIMENT 97.—January 14. Smears of Streptococcus pyogenes were made upon agar solidified in a Petri dish; upon these a piece of iodine gut was placed. January 15, a few colonies developed towards the ends of some of the streaks, all far away from the catgut. Observations taken until January 21, but no further change noted.

EXPERIMENT 98.—January 14. Smears of Streptococcus pyogenes were made upon agar solidified in a Petri dish; upon these a piece of von Bergmann catgut was placed. January 15, numerous colonies developed, but none nearer than one-half inch from the catgut. Observations taken until January 21, but no further change noted.

Even a hasty examination of the experiments just related, and particularly of the accompanying photographs, at once calls attention to two phenomena; first, the relatively large area, upon the plates made with iodine gut, which is free from any growth, more particularly when compared with the control plates made with von Bergmann catgut. It is, of course, difficult to express exactly in figures how much larger the area is around the iodine catgut than around the von Bergmann catgut; but I believe myself to be within safe limits if I judge that it is at least four times as great. Secondly, though relatively small, there is still an area free from growth also surrounding the von Bergmann catgut. It is self-evident that the large area surrounding the iodine catgut is due to the powerful antiseptic properties of the free iodine contained therein; and it was but natural to assume some similar agent, *e.g.*, $HgCl_2$, was also present in the von Bergmann catgut. Dr. Bookman, physiological chemist of Mount Sinai Hospital, was kind enough to undertake for me a chemical analysis. He found that one yard of No. 1 catgut prepared by the von Bergmann method contained an amount of mercury which would be equivalent to 0.008825 of $HgCl_2$; this will readily explain the relatively small sterile area upon the plates.

I am particularly pleased to acknowledge this work of Dr. Bookman, as at first I was at a loss to account for the non-appearance of any growth in the plates made with the von Bergmann catgut. I personally was always under the impression that in the von Bergmann catgut we are dealing with an aseptic catgut, and not with an antiseptic catgut; but the results obtained in the chemical analysis prove the contrary. It appears that the bichloride of mercury used in the preparation of the catgut enters into a chemical combination with the organic substances, probably some form of albuminate, which evidently has antiseptic properties as well.

It is patent to everybody that the sterility of the iodine catgut is due to the antiseptic action of the iodine contained therein; but it was of interest to me, also, to know just how much iodine was contained in a given piece of iodine catgut.

Analysis by Dr. Bookman revealed the presence of 0.025737 of iodine in one yard of No. 1 iodine catgut. If it is recollected that a 1 to 5000 aqueous solution of iodine is still a very powerful antiseptic, it will be seen that one and one-half inches of No. 1 catgut will be amply sufficient to render absolutely sterile 8 cubic centimetres of medium, the amount generally used for bacteriological purposes.

It might, and with a certain amount of justice, be argued that in the experiments just related, the iodine exerts merely an inhibitory action upon the development of the bacteria, and that there are still numerous active and living bacteria in the clear area surrounding the catgut, which are only temporarily prevented from developing, but which would still develop when placed in more favorable surroundings. In order to disprove such a possibility, I have made the following experiments:

EXPERIMENT A. EXPERIMENT 162.—January 29. A tube of liquefied agar-agar was inoculated with a virulent culture of Bacillus anthracis, and poured into a Petri dish. After solidification, a piece of iodine catgut was placed upon it. January 30, numerous colonies developed, but none in an area extending over one inch on either side of the catgut. February 1, no further change noted.

EXPERIMENT 164.—January 30. A liberal inoculation was made from the clear agar surrounding the iodine catgut in Experiment 162, and about one-half inch away from it, into bouillon. January 31, no growth. Observations taken until February 5, but no further change noted.

EXPERIMENT 166.—January 30. Repetition of Experiment 164 in agar and Petri dish also gave a negative result.

But even this series of experiments may not be considered absolutely conclusive, as it might be argued that the conditions with the bouillon in Experiment 164, or with the agar in Experiment 166, were still not sufficiently favorable for the development of the anthrax bacilli. I therefore supplemented them with the following animal experiment.

EXPERIMENT 172.—February 4. After proper preparation and antiseptic precautions, a small incision was made upon the back of a guinea-pig, and with dressing-forceps a small pocket was prepared. Into this there was buried a piece of the clear agar surrounding the catgut in Experiment 162, about one-half inch square and about one-sixteenth

of an inch thick. February 5, no reaction. February 11, animal still alive and perfectly well.

Surely in this test all the conditions favorable for the development of any bacteria were present; and if the high virulence of the particular anthrax culture used be considered, we must assume that death of the animal should have followed, provided there were still living, though undeveloped, bacteria in the clear space surrounding the catgut.

In corroboration of this fact, I might also adduce the argument that all of my plates were observed for a number of days in the thermostat, and that I have found that already after twenty-four hours, owing to the temperature of the thermostat, and owing to the chemical affinity free iodine has for the various salts contained in the nutritive media, the catgut has lost its black color, nor could I get the well-known reaction for iodine with starch. It follows therefore that any agency which the iodine may have upon the non-development of bacteria must be exerted in the beginning; assuming merely an inhibitory action, this would certainly cease after the iodine has been driven off by volatilization; but as no bacteria develop in the clear space even after long-continued observation, we must come to the conclusion that the iodine acts not merely as an inhibitory agent, but as a true bactericide.

I know full well that the human body is not a culture tube nor a guinea-pig, and that numerous other conditions, which exist in the human body and not in the Petri dish, must be taken into account; but I believe we may safely deduct this much from this series of experiments, namely, that the iodine catgut will, at least in a measure, assist in neutralizing accidental infections in wounds.

C. *Tests to show the Effects of Infected Catgut.*—I now come to the most interesting series of my experiments,—interesting because they were entirely unlooked for and surprising, and also because they are so very important from the surgeon's stand-point. This series of experiments goes to prove in a bacteriological sense that the iodine catgut is practically non-infectible. The importance of this point will be readily appre-

ciated when it is remembered that accidental contact-infections of the catgut are so manifoldly possible, that a careful supervision of any operation goes to show that these accidental contact-infections, in spite of all care to eliminate them, are not only not exceptional, but the rule. The surgeon's and assistants' hands, as well as the skin of the patient, can never be rendered absolutely sterile, but only relatively so. The surgeon and assistants may even avoid direct contact with the catgut by wearing rubber gloves, but the skin of the patient cannot be so protected, and yet the catgut, if used as a suture, must pass through it. This results, as we all know, in an occasional stitch abscess, and from time to time in more serious infections. I venture to say that even these may be eliminated with the aid of iodine catgut.

The method of procedure was the following: Bouillon cultures were made of the following actively growing bacteria: Bacillus coli; Staphylococcus aureus; Streptococcus pyogenes; Bacillus anthracis, and Bacillus subtilis. This culture was kept in the thermostat for twenty-four hours. At the expiration of this time, when an abundant growth had resulted, the culture was divided into two halves, and poured into sterile Petri dishes; into one dish there were placed about one dozen pieces of iodine catgut, about one inch in length, and into the other a similar number of von Bergmann catgut of the same length. Both dishes were then replaced for another twenty-four hours into the thermostat. At this time the excess of culture medium was poured off, and various tests made with the catgut (in the experiments this is called "wet catgut"); the balance was replaced for another twenty-four hours into the thermostat, and another set of experiments was made with it (in the experiments this is called "dry catgut").

EXPERIMENT 43.—January 5. Iodine gut infected with Bacillus coli "wet" planted into bouillon. January 6, no growth, nor at any time until January 14, when further observation was discontinued.

EXPERIMENT 44.—January 5. Von Bergmann catgut infected with Bacillus coli "wet" planted into bouillon. January 6, growth. Observations taken until January 14, but no further change noted.

EXPERIMENT 45.—January 5. Iodine gut infected with Staphylococcus

aureus "wet" planted into bouillon. January 6, no growth, nor at any time until January 14, when further observation was discontinued.

EXPERIMENT 46.—January 5. Von Bergmann catgut infected with Staphylococcus aureus "wet" planted in bouillon. January 6, growth. Observations taken until January 14, but no further change noted.

EXPERIMENT 115.—January 17. Iodine gut infected with Bacillus anthracis "wet" planted in bouillon. January 18, no growth, nor at any time until January 26, when further observation was discontinued.

EXPERIMENT 116.—January 17. Von Bergmann catgut infected with Bacillus anthracis "wet" planted into bouillon. January 18, no growth. January 19, growth. Observations taken until January 26, but no further change noted.

EXPERIMENT 117.—January 17. Iodine gut infected with Bacillus subtilis "wet" planted in bouillon. January 18, no growth, nor at any time until January 26, when further observation was discontinued.

EXPERIMENT 118.—January 17. Von Bergmann catgut infected with Bacillus subtilis "wet" planted in bouillon. January 18, growth. Observations taken until January 26, but no further change noted.

EXPERIMENT 119.—January 17. Iodine gut infected with Streptococcus pyogenes "wet" planted in bouillon. January 18, no growth, nor at any time until January 26, when further observation was discontinued.

EXPERIMENT 120.—January 17. Von Bergmann catgut infected with Streptococcus pyogenes "wet" planted in bouillon. January 18, growth. Observations taken until January 26, but no further change noted.

These ten experiments made with the two varieties of catgut, after having been literally soaked for twenty-four hours in a twenty-four-hour old culture of actively growing bacteria, show that the iodine content of the iodine catgut was sufficient at least to inhibit, if not destroy, the development of bacteria with which it came in contact, since all the experiments with the iodine catgut gave a negative result, while all the experiments with the von Bergmann catgut gave a positive result. As in actual practice, however, we are using the catgut dry, it was necessary to repeat all these experiments, also, with the dried catgut. Following were the results obtained:

EXPERIMENT 47.—January 6. Iodine gut infected with Bacillus coli "dry" planted in bouillon. January 7, no growth, nor at any time until January 14, when further observation was discontinued.

EXPERIMENT 48.—January 6. Von Bergmann catgut infected with Bacillus coli "dry" planted in bouillon. January 7, growth. Observations taken until January 14, but no further change noted.

EXPERIMENT 49.—January 6. Iodine gut infected with Staphylococcus

aureus "dry" planted in bouillon. January 7, no growth, nor at any time until January 14, when further observation was discontinued.

EXPERIMENT 50.—January 6. Von Bergmann catgut infected with Staphylococcus aureus "dry" planted in bouillon. January 7, no growth. January 8, growth. Observations taken until January 14, but no further change noted.

EXPERIMENT 121.—January 18. Iodine gut infected with Bacillus anthracis "dry" planted in bouillon. January 19, no growth, nor at any time until January 26, when further observation was discontinued.

EXPERIMENT 122.—January 18. Von Bergmann catgut infected with Bacillus anthracis "dry" planted in bouillon. January 19, no growth. January 20, no growth. Observations taken until January 26, but no further change noted. (The only negative experiment in the entire series!)

EXPERIMENT 123.—January 18. Iodine gut infected with Bacillus subtilis "dry" planted in bouillon. January 19, no growth, nor at any time until January 26, when further observation was discontinued.

EXPERIMENT 124.—January 18. Von Bergmann catgut infected with Bacillus subtilis "dry" planted in bouillon. January 19, growth. Observations taken until January 26, but no further change noted.

EXPERIMENT 125.—January 18. Iodine catgut infected with Streptococcus pyogenes "dry" planted in bouillon. January 19, no growth, nor at any time until January 26, when further observation was discontinued.

EXPERIMENT 126.—January 18. Von Bergmann catgut infected with Streptococcus pyogenes "dry" planted in bouillon. January 19, growth. Observations taken until January 26, but no further change noted.

I have repeated the experiments just related also with agar media; their object is merely to serve as a better object lesson. The procedure was the following: Agar-agar was liquefied and poured into Petri dishes. After solidification, a piece of the dry catgut, infected according to the method before described, was placed upon it, and the subsequent behavior noted. Following was the result of these experiments:

EXPERIMENT 72.—January 12. Iodine gut infected with Bacillus coli "dry" placed upon agar. January 13, no growth, nor at any time until January 17, when further observation was discontinued. (See illustration.)

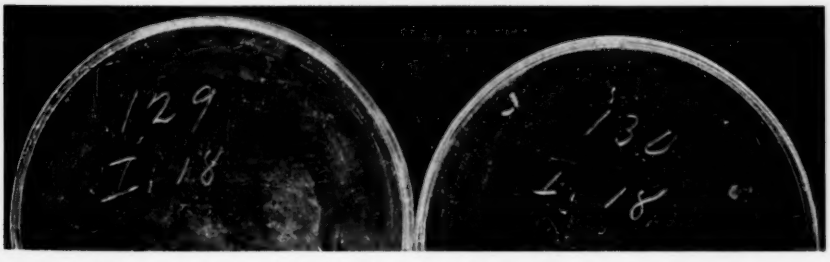
EXPERIMENT 73.—January 12. Von Bergmann catgut infected with Bacillus coli "dry" placed upon agar. January 13, growth. Observations taken until January 17, but no further change noted. (See illustration.)

EXPERIMENT 74.—January 12. Iodine gut infected with Staphylococcus aureus "dry" placed upon agar. January 13, no growth, nor at any

No. 72. Iodine gut infected with Bacillus coli "dry" on agar.
No. 73. Von Bergmann gut infected with Bacillus coli "dry" on agar.

No. 74. Iodine gut infected with Staphylococcus aureus "dry" on agar.
No. 75. Von Bergmann gut infected with Staphylococcus aureus "dry" on agar.

No. 127. Iodine gut infected with Bacillus anthracis "dry" on agar.
No. 128. Von Bergmann gut infected with Bacillus anthracis "dry" on agar.



No. 129. Iodine gut infected with Bacillus subtilis "dry" on agar.
No. 130. Von Bergmann gut infected with Bacillus subtilis "dry" on agar.

time until January 17, when further observation was discontinued. (See illustration.)

EXPERIMENT 75.—January 12. Von Bergmann catgut infected with Staphylococcus aureus "dry" placed upon agar. January 13, growth. Observations taken until January 17, but no further change noted. (See illustration.) (In this illustration the large colony at the upper end is an accidental mould, but the small, fine colonies along the lower end are typical staphylococci.)

EXPERIMENT 127.—January 18. Iodine gut infected with Bacillus anthracis "dry" placed upon agar. January 19, no growth, nor at any time until January 26, when further observation was discontinued. (See illustration. No attention is to be paid to the accidental contamination to the right of this illustration, nor in the next illustration.)

EXPERIMENT 128.—January 18. Von Bergmann catgut infected with Bacillus anthracis "dry" placed upon agar. January 19, no growth. January 20, growth. Observations taken until January 26, but no further change noted. (See illustration.)

EXPERIMENT 129.—January 18. Iodine gut infected with Bacillus subtilis "dry" placed upon agar. January 19, no growth, nor at any time until January 26, when further observation was discontinued. (See illustration.)

EXPERIMENT 130.—January 18. Von Bergmann catgut infected with Bacillus subtilis "dry" placed upon agar. January 19, growth. Observations taken until January 26, but no further change noted. (See illustration.)

EXPERIMENT 131.—January 18. Iodine gut infected with Streptococcus pyogenes "dry" placed upon agar. January 19, no growth, nor at any time until January 26, when further observation was discontinued.

EXPERIMENT 132.—January 18. Von Bergmann catgut infected with Streptococcus pyogenes "dry" placed upon agar. January 19, no growth. January 20, growth. Observations taken until January 26, but no further change noted.

The thirty experiments last enumerated are of the utmost importance, because they more nearly approach the use of catgut in actual practice. They show that at least, as far as the bacteriological test is concerned, the iodine catgut is far superior to the von Bergmann catgut, inasmuch as it is absolutely "uninfectible." All experiments with the iodine catgut gave an absolutely negative result, while with one exception (Experiment 122) all experiments made with the von Bergmann catgut gave a positive result. Again, I would call attention to the fact that the living human organism is not a culture tube, and it would be wrong to transfer inferences from these test-tube and Petri dish experiments to the operating room; but

they certainly show this at least, that those constantly occurring, accidental, and unavoidable infections are of no harm if they occur with iodine catgut, while similar infections of the von Bergmann catgut may be productive of the greatest harm.

In addition to the above experiments, I have also made a few experiments with iodine gut after infecting it with pus from various sources. Of course, these experiments lose in actual value when compared with those just related, in which we deal with certain definite and positive infections; but they appeal perhaps more to the surgeon, as they deal with infections which might occur at any time in an operating room, or even in the course of an individual operation.

EXPERIMENT 51.—January 10. On January 9 I had occasion to operate a metastatic empyema, caused by streptococci, the presence of which was verified both by slides and cultures. A basin of the pus was caught in a sterile vessel, and in it there was placed a spool of iodine catgut. After an immersion of six hours it was removed and placed into a sterile bottle, with large amounts of the pus still adhering to it. Fourteen hours later (*i.e.*, twenty hours after beginning the experiment) a piece of the catgut about one inch in length was planted into bouillon. January 11, no growth, nor at any time until January 16, when further observation was discontinued.

To refute the possible argument that in this as in other experiments the amount of iodine contained in the catgut was sufficient to render the small quantity of bouillon antiseptic, the following experiment was made:

EXPERIMENT 64.—January 11. A piece of the catgut used in Experiment 51, about one inch in length, was planted into a large quantity (60 cubic centimetres) of bouillon, forty hours after the empyema operation. January 12, no growth, nor at any time until January 18, when further observation was discontinued.

EXPERIMENT 70.—January 12. Iodine catgut was liberally smeared in the pus of a freshly opened furuncle of the neck (staphylococcus in spreads), and one hour later a piece one inch in length was planted into bouillon. January 13, no growth, nor at any time until January 18, when further observation was discontinued.

EXPERIMENT 71.—January 12. Iodine catgut was liberally smeared in the pus of an axillary abscess (staphylococci in spreads), and one hour later a piece one inch in length was planted into bouillon. January 13, no growth, nor at any time until January 18, when further observation was discontinued.

EXPERIMENT 76.—January 13. The iodine gut used in Experiment 70 was allowed to remain in contact with the pus, and twenty-six hours later, by which time it had become perfectly dry, a piece one inch in length was planted into bouillon. January 14, no growth, nor at any time until January 21, when further observation was discontinued.

EXPERIMENT 77.—January 13. The iodine gut used in Experiment 71 was allowed to remain in contact with the pus, and twenty-six hours later, by which time it had become perfectly dry, a piece one inch in length was planted into bouillon. January 14, no growth, nor at any time until January 21, when further observation was discontinued.

EXPERIMENT 78.—January 13. Iodine gut was smeared in the pus of a freshly incised large periproctitic abscess, communicating by a fistulous tract with the rectum (numerous cocci and bacilli in spreads), and one hour later a piece one inch in length was planted into bouillon. January 14, no growth, nor at any time until January 21, when further observation was discontinued.

EXPERIMENT 80.—January 14. The iodine gut used in Experiment 78 was allowed to remain in contact with the pus for twenty-five hours, by which time it had become perfectly dry, and a piece one inch in length was planted into bouillon. January 15, no growth, nor at any time until January 21, when further observation was discontinued.

EXPERIMENT 82.—January 14. Iodine gut was smeared into the pus of a freshly incised suppurative arthritis of the elbow-joint, and one hour later a piece one inch in length was planted into bouillon. January 15, no growth, nor at any time until January 21, when further observation was discontinued.

On this occasion I repeated the experiment also with von Bergmann catgut, and, as was to be expected, obtained a positive result.

EXPERIMENT 83.—January 14. Von Bergmann catgut was smeared into the pus of a freshly incised suppurative arthritis of the elbow-joint, and one hour later a piece one inch in length was planted into bouillon. January 15, growth.

In addition, I have made numerous experiments in the following manner: Pieces one inch in length were cut with an ordinary old unsterilized pair of scissors, from spools of iodine catgut, which had lain some time for months in a not overclean laboratory drawer, and planted into bouillon, but at no time was a growth obtained.

All of the experiments just related show that at least, as far as culture experiments go, not only is the iodine catgut absolutely sterile, but also that it is absolutely impossible to infect it, either with cultures of known activity or with resistant spores, or with ordinary pus.

Advisedly and with caution have I used in my *résumé* the expression that these results are true as far as the culture experiments are concerned, as I expected that the objection would be raised that in an operation we would have to deal with conditions which materially differ from any laboratory experiment. This was brought to my attention by Dr. Lilienthal, of Mount Sinai Hospital, who conceded that the catgut was sterile, and also that it was uninfectible, provided sufficient time was given for the iodine to exert its antiseptic action. He argued that in the course of an operation infections of the catgut might occur, which catgut being used immediately thereafter, before the iodine had sufficient time to exert its bactericidal action, might possibly cause an infection in this manner. Dr. Lilienthal was of the opinion that a nearer approach to the actual use of the catgut could be obtained in the following manner: That catgut infected with various germs is inoculated into a nutritive medium, but is removed therefrom in a few seconds. While conceding the validity of the argument, I would not concede the validity of the experiment, but, *experimenti causa,* I have carried out the tests suggested, using both iodine and von Bergmann catgut; the result of which in brief is the following:

EXPERIMENT 133.—January 19. Immersion for a few seconds of iodine gut infected with Bacillus coli into bouillon was followed by no growth.

EXPERIMENT 134.—January 19. Immersion for a few seconds of von Bergmann catgut infected with Bacillus coli into bouillon was followed by a growth.

EXPERIMENT 135.—January 19. Immersion for a few seconds of iodine gut infected with Staphylococcus aureus into bouillon was followed by no growth.

EXPERIMENT 136.—January 19. Immersion for a few seconds of von Bergmann catgut infected with staphylococcus aureus into bouillon was followed by no growth.

EXPERIMENT 137.—January 19. Immersion for a few seconds of iodine gut infected with Bacillus anthracis into bouillon was followed by no growth.

EXPERIMENT 138.—January 19. Immersion for a few seconds of von Bergmann catgut infected with Bacillus anthracis into bouillon was followed by no growth.

EXPERIMENT 139.—January 19. Immersion for a few seconds of iodine gut infected with Bacillus subtilis into bouillon was followed by no growth.

EXPERIMENT 140.—January 19. Immersion for a few seconds of von Bergmann catgut infected with Bacillus subtilis into bouillon was followed by a growth.

While, as already stated, I do not concede the validity of the argument that the experiments just related are a closer approach to infections as they might occur accidentally in the course of an operation, they are of interest in so far that they also tend to prove that it is impossible to get infections with the iodine catgut in this manner; all the experiments with iodine catgut gave a negative result, while on the other hand two out of the five experiments with the von Bergmann gut (the coli and subtilis experiment) gave a positive result.

In order to determine the possibility of such infections, experiments would have to be done actually upon the human body; but, as this would be entirely too risky and dangerous, no one will reproach me with the incompleteness of my studies. I have attempted to approach this form of infection with animal experiments, and following is the result:

EXPERIMENT 148.—January 27. On January 26 I made a bouillon culture of an actively growing, virulent Bacillus anthracis, and permitted it to grow for twenty-four hours in the thermostat. On January 27 I made a small incision upon the back of a guinea-pig, and bluntly made therein a subcutaneous channel; into this I buried two pieces of iodine catgut about two inches in length, which had been dipped into the anthrax culture, and closed the opening with a suture. January 28. The animal looked and acted perfectly well, and, in spite of this extremely severe test, I had strong hopes that the animal might overcome the infection. In this I was disappointed, as on the following morning, January 29, the animal was found dead.

EXPERIMENT 147.—January 27. In this experiment I repeated in all details Experiment 148, with the exception that I used von Bergmann catgut. On January 28 the animal looked and acted sick and refused its nourishment. On the following morning, January 29, the animal was found dead.

It is seen, therefore, that both these experiments (148 and 147) gave a negative result, inasmuch that both animals died. Nor could I expect anything different; and I so ex-

pressed myself at the time I operated upon the animals. I know that sufficient of the culture adhered to the dripping wet catgut to kill any animal, and I also know that in the introduction of the catgut sufficient of the culture medium was wiped upon the wound at some distance from the iodine catgut to cause an infection and death. The only conclusion to be reached, therefore, is that both animals died in consequence of a surcharge of the infective medium; and I am sure every one will agree with me that this is not the way catgut infections occur in the course of an operation, even if we would concede the possibility of anthrax infection.

It was necessary, therefore, to find a method which would more nearly approach the conditions as they might occur in practice. I believe I have found it by proceeding in the following manner:

EXPERIMENT 170.—February 4. Two pieces of iodine gut, about two inches in length, were thoroughly moistened in a twenty-four-hour bouillon culture of virulent anthrax; they were then dried between folds of sterile blotting-paper, and immediately buried in a channel beneath the skin of the back of a guinea-pig. February 5, the animal looks and acts perfectly well. February 6, apparently no change in the condition and behavior of the animal. February 7, the animal was found dead in its cage.

EXPERIMENT 171.—February 4. Repetition of Experiment 170, with the difference that in place of iodine catgut von Bergmann catgut was used. February 5, the animal was found dead in its cage.

It is seen that the last two experiments (170 and 171) were followed by the same result as the more severe experiments (147 and 148); both animals, the one with infected iodine gut as well as the one with infected von Bergmann catgut, died. It is true that the former outlived the latter by forty-eight hours, but that is, and should be, no criterion. What we are looking for are positive results in the form of complete immunity, and not merely prolongation of life; at best, we are entitled perhaps merely to deduct so much from these experiments that the iodine catgut was sufficiently strong to neutralize some of the anthrax bacilli, but there still remained sufficient to eventually kill the guinea-pig. Even this,

however, would be some encouragement from the surgeon's point of view, as it must be recollected that, as a general rule, we are not working with catgut which has been soaked, like in the experiments related, in virulent anthrax cultures.

All in all, I do not see how we could imitate the conditions exactly to fulfil the objections raised by Dr. Lilienthal. It is true that I could perhaps repeat the experiments with bacteria, which are less fatal than anthrax, for instance, with the ordinary pus-forming germs, but I do not see that much would be gained by it. For instance, the presence of pus would by no means be proof of the inefficiency of the iodine catgut, as it might be argued that the purulent infection was introduced otherwise and not with the catgut. I confess, therefore, that, for the want of a good method, I am for the present unable to refute Dr. Lilienthal's argument.

The result of the various experiments carried out to prove the sterility of the catgut are to my mind so convincing that a general *résumé* is hardly indicated.

2. TENSILE STRENGTH.—Having proven the aseptic and antiseptic properties of iodine catgut, it remained for me to show that its tensile strength was not inferior, and perhaps superior, to other forms of catgut.

It is not sufficient to state that in actual use we have found that the catgut was sufficiently strong for all the requirements, or all the demands made upon it; nor can much value be put upon the statements of others that the catgut was too weak, and that it has lost a considerable part of its tensile strength. A great deal depends upon the personal equation of the individual who is using or testing it. If "A" wishes to prove that any catgut is strong, he does not pull quite as hard as "B," who wishes to prove that the catgut is weak, and *vice versa*. The only way to either prove or disprove anything of this nature is by actually and accurately measuring the amount of pulling force applied. This would be comparatively easy with most substances, but with catgut it is surrounded by almost insurmountable difficulties. This is due to many facts about

catgut, all of which have a most important bearing upon its tensile strength. First, there exist no accurate standard sizes of catgut. It is true that we can buy in the market so-called standard sizes, which are variously labelled from oo upward; but in reality this does not mean anything, as anybody can readily convince himself by simply glancing at a number of rolls. I have, for instance, frequently examined packages of catgut marked for a certain size, and found all possible variations, both above and below the size stated; in some of the larger sizes measured (No. 2) with an accurate micrometer the variations were as much as fifteen one-hundredths of a millimetre in diameter. Fifteen one-hundredths of a millimetre may appear a triviality, but in reality it makes a very great difference, as the strength of a given piece of material varies not as does the diameter, but as does the square of the diameter. Second, there is an important variation in size, not only between different rolls, but also in different parts of the same roll, and we find thinner portions alternating with thicker portions; and it is perhaps needless to add that a given piece of the catgut is only as strong as its weakest portion. Third, that the strength of the catgut depends not only on its diameter, but also upon other undetermined qualities, which vary not only in different rolls, but also in different portions of the same roll, *e.g.*, light portions alternate with dark portions, translucent with almost transparent portions, alternate with opaque portions. Finally, that the strength of the catgut depends upon the workmanship originally used in its preparation; I mean how tightly it was originally twisted to get a diameter of a certain size. It is self-evident that of two pieces of catgut of equal diameter that one will be stronger which is twisted tighter, because in reality there is much more catgut substance in it. I have paid a good deal of attention to this point, and finally, by a mere glance, I could tell beforehand which catgut would be strong and which weak. All in all, it is seen that this was by no means an easy question to solve.

But after making due allowance for these qualities inherent to the catgut, there arose a further difficulty, inasmuch

as I was not in possession of any apparatus by which I could accurately determine its tensile strength. The crude affairs that I was able to rig up were not sufficiently accurate, and

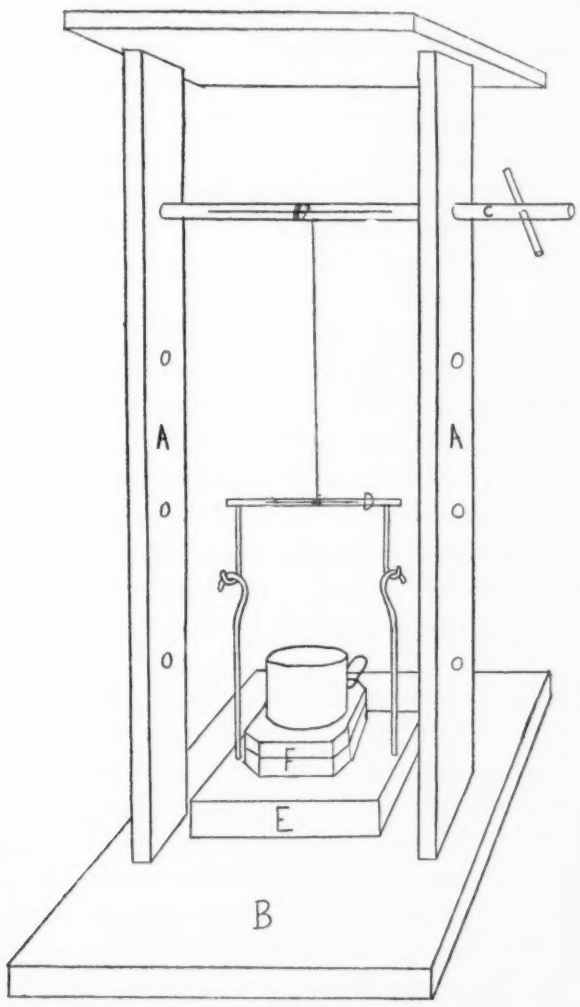


FIG. 1.—Apparatus to test tensile strength of catgut.

were so cumbersome that I could not make sufficient headway. In this dilemma I consulted Professor Hallock, of the Department of Physics, at Columbia University; as no apparatus was

on hand to determine the tensile strength of catgut, Dr. Forbes, of the Department of Physics, of Columbia University, very kindly designed and constructed the following apparatus for me (Fig. 1).

The instrument consists of two parallel vertical bars (A, A) firmly fixed in a stand (B) and connected above. The sides of A and A are perforated at different heights, and through any pair of these holes a cross-bar (C) made of brass may be firmly fixed; the latter is perforated by a long slit and fine openings, through which the catgut may easily be threaded; by a few rotations of C the catgut will be held solidly, and yet will hang only in a tangent from the round surface of C, so as not to be cut by any sharp edge. The other end of the catgut is then fixed in a similar manner to another brass bar (D) which supports a suspended platform (E). This platform in turn supports any number of weights (F) which may be placed upon it. On top of the weights there rests a small cup into which shot may be poured. When the amount of shot poured in is sufficient to break the catgut, it is weighed and the amount added to the original weights first placed upon the platform, plus the weight of the other suspended parts of the apparatus, which, of course, have previously been determined.

While this apparatus is by no means perfect, we believe it to be more devoid of gross errors than apparatus which work with a spring-balance, as it enables us to get nearer to the actual breaking strength of an individual piece of catgut. Soon after the construction of the apparatus, however, I found that a great deal depended on the intrinsic characteristics of the catgut, and that it would not do to merely measure a single piece of the catgut of a given size, and from it to draw the conclusion that this size of catgut has a given breaking-point. The figures vary so much, that the only way to determine this was to determine the breaking-point of many rolls, and from different parts of the same roll, and then to draw the final deduction from the grand average.

Following is the result of my measurements:

NUMBER 0 CATGUT.

Iodine Catgut. Grammes.	Von Bergmann Catgut. Grammes.	Raw Catgut. Grammes.
2827	3595	2801
3778	3691	3226
2616	2731	3216
4241	3136	
3791	3013	
3576	2912	
3696	3078	
4182	3126	
4017	2987	
3928	3175	
Av'age, 3665	3180	3081

NUMBER 1 CATGUT.

Iodine Catgut. Grammes.	Von Bergmann Catgut. Grammes.	Raw Catgut. Grammes.
4723	4681	4561
4067	3866	4866
4916	4421	5456
6186	4567	
5796	4658	
4911	4649	
5941	5018	
6076	4925	
5866	4532	
5978	4612	
Av'age, 5446	4592	4961

NUMBER 2 CATGUT.

Iodine Catgut. Grammes.	Von Bergmann Catgut. Grammes.	Raw Catgut. Grammes.
7150	7291	6896
7251	7520	6686
6526	7440	6496
7080	6975	
8716	6942	
6826	7257	
7043	7261	
7251	7223	
7120	6711	
8239	6709	
Av'age, 7320	7132	6526

While this gives us an excellent and very fair idea of the tensile strength of the catgut as it is used for suture material, it is by no means the tensile strength of the catgut as it is used for ligatures, particularly for tying heavy pedicles; because in the latter we have to deal, in addition, with the knot problem, which was found to be a most important element in the tensile strength of catgut. It was necessary, therefore, to repeat all of these experiments with the addition of a knot in the catgut measured; for the sake of simplicity only a single knot was tied; no doubt a surgeon's knot would give still greater differences.

Following was the result of these measurements:

NUMBER 0 CATGUT.

Iodine Catgut. Grammes.	Von Bergmann Catgut. Grammes.	Raw Catgut. Grammes.
2146	Less than 1000 *	2076
2151	Less than 1000 *	2021
2166	Less than 1000 *	1856
2351	2346	
2306	2161	
2243	2246	
2116	2361	
2296	2111	
Av'age, 2220	2244	1984

NUMBER 1 CATGUT.

Iodine Catgut. Grammes.	Von Bergmann Catgut. Grammes.	Raw Catgut. Grammes.
2821	3068	3230
2786	3148	2871
2655	4106	2886
3783	2900	
3113	3801	
3491	3946	
4321	2995	
4196	3161	
4229	4120	
4176	3221	
Av'age, 3557	3446	2996

* Not figured in the average.

NUMBER 2 CATGUT.

Iodine Catgut. Grammes.	Von Bergmann Catgut. Grammes.	Raw Catgut. Grammes.
4431	5636	3961
4885	5541	3513
4011	5840	3928
4138	4005	
4126	5311	
4081	5124	
4951	5146	
4306	5634	
5356	5214	
5606	5139	
5066	5071	
5184	4923	
Av'age, 4678	5217	3800

The tests with the unknotted catgut, in spite of the great variability in strength, show that the raw catgut is by far the weakest of the three, and that the iodine gut is by far the strongest; this is particularly the case with the smaller sizes, the size most frequently used both as suture and ligature material.

If we now turn our attention to the knotted catgut, we again find that the raw catgut is by far the weakest; Numbers 0 and 1 have practically the same tensile strength if prepared with iodine as with the von Bergmann method, though even here there is some advantage in favor of the iodine catgut; but with the Number 2 catgut there is evidently some advantage in favor of the von Bergmann catgut. I believe, however, that this is merely accidental, as in some spools the iodine catgut gave just as high values as the best of the von Bergmann catgut. It is not impossible that more extensive measurements will equalize these values.

All in all, I am perfectly satisfied that the iodine catgut has not only not lost any of its tensile strength, but apparently it has materially gained.

3. METHOD OF PREPARATION.—Under this heading I can only repeat what I have already stated in my article previously referred to, viz., " The preparation of this catgut is simplicity

itself." But, for the sake of completeness and because of a slight modification in its preservation, it may perhaps not be amiss if I again go into detail regarding this point. The catgut, just as it is bought from the dealers, *i.e.*, without removing the fat, is loosely wound, preferably in a single layer, on to the spool, and tied at both ends in order to prevent unravelling. It is then immersed for eight days in a solution of iodine, one part; iodide of potassium, one part; distilled water, one hundred parts. (The solution is prepared by dissolving the iodide of potassium in a small quantity of the water, to which the iodine, previously finely pulverized, is added, and the whole diluted up to one hundred parts.)

According to Claudius's directions, the catgut was preserved in the original solution without any change; but as already stated, having found that after long-continued immersion in the solution the catgut loses some of its tensile strength, it was necessary to obviate or circumvent this drawback. This was done in a very simple manner, inasmuch as all that was necessary was to remove the catgut from the solution at the end of the eight days, and to preserve it thereafter merely dry in a sterile vessel, preferably in one not exposed to the light. (If necessary, the drying process might be hastened by placing to one side of the vessel in which the catgut is kept a small vial containing a little sulphuric acid.) In short, formerly we used a catgut which was wet, and by the newer method we use it dry.

It is used dry just as it is cut from the spool, without any previous immersion in carbolic solution or sterile water. Any unused catgut may be resterilized on a future occasion.

That this method of preparation is simple no one can deny; that it is extremely cheap, itself no mean item, particularly in large hospitals, where quantities are used, is also self-evident; one gallon of the solution, requiring 608 grains of iodine and an equal amount of iodide of potassium, costing only forty-two cents.

It is important to keep the solution in well-stoppered bottles or jars because the iodine is volatile, as can be seen by

the purple color of the atmosphere on top of the solution, and in time it deteriorates. Solutions good enough to use should in bulk have a deep brown, almost black color; any solution not corresponding to these physical requirements should be discarded.

The new method of preservation has produced also a change in the physical properties of the catgut, and, I regret to say, in some respects this change is a slight disadvantage; but even then it is better than catgut which is used out of alcohol. At present it is of a deep brown, almost black color, and still retains the characteristic odor of iodine; it is perfectly smooth, not swollen, as one might expect from its immersion in an aqueous solution. The old Claudius catgut was exceedingly convenient to use, as it did not kink, nor curl up like catgut used from alcohol; but this newer catgut is somewhat stiff, like a fine wire, but it has no tendency to kink up, and particularly when it is used as a suture it soon becomes soft and straight. All in all, a long-continued use of it has proven to me its superiority also in this direction over alcohol catgut.

4. Absorption.—Regarding this point, we have not made any recent observations. From a practical stand-point, I may say that the knots stay tight and do not tend to untie or loosen, and we have never seen any untoward symptoms which could be traced to a too early or too late absorption.

In this connection it might be of interest to mention that Dr. Bookman has attempted to gain experimentally some idea regarding its absorption, and he found that the von Bergmann catgut was completely digested in twenty-four hours in artificial gastric juice (pepsin and HCl); while on the other hand the same amount of iodine catgut was only partially disintegrated in seventy-two hours. From this we would be entitled to conclude that the iodine catgut is more resistant to absorption than the von Bergmann catgut, were it not for the fact that conditions in the body are different from the test-tube; in the latter we have a definite quantity of digesting fluid, but in the former we have leucocytes and constantly changing currents, which no doubt materially aid in absorp-

tion. In general, we may say that there is no material difference regarding the time of absorption between this and catgut prepared by other methods.

DISADVANTAGES.—Of these I know none, but, in order to prevent any misconception, it will perhaps be wise if I briefly mention those possibilities which might be raised against it.

The toxic effect of the iodine might cause some anxiety in the minds of some surgeons. There need be no fear on this account, because, first, even in the most extensive operation, *e.g.*, radical operation for carcinoma of the breast, the toxic dose can never be reached; second, because the iodine is divided so minutely that it quickly enters into a chemical combination with the salts of the body fluids, and forms only innocuous iodine compounds, etc., and third, because of late, after being so astonished at the almost marvellous antiseptic properties of the iodine solution, I have in a large number of cases used iodine solution for dressing wounds, using at each dressing large quantities of gauze dipped into iodine solution, but in no instance did I find even the slightest trace of irritation. (I may state here that I am now at work experimenting extensively with iodine gauze as a dressing, and thus far my experiments are so encouraging that I intend to publish the results at some future date.) For the reasons stated, I may also reply to the objections of those who fear that the iodine may act as an irritant upon the tissues.

The odor of the catgut and the staining of the linens are so trivial that they do not even merit discussion; particularly is this true of the latter, as by experience we have found that the stains are not permanent and readily disappear in the laundrying process.

I believe that our clinical experience and the experimental work as related in this paper fully justify the following conclusions:

1. The "dry" iodine catgut is absolutely sterile.
2. It is impossible to infect it by ordinary means.
3. Its imbibition with iodine is not sufficient to act as an irritant upon the tissues.

4. Its tensile strength is superior to raw catgut and to that prepared by the sublimate-alcohol method.

5. It is easily and cheaply prepared.

6. It is absorbed only after it has served the purposes for which it was intended.

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DENTIGEROUS CYST OF THE LOWER JAW.[1]

SITUATED AT THE SYMPHYSIS MENTI.

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THE patient, a man, twenty-one years of age, at the age of sixteen years first noticed a lump, the size of a small marble, below the lower left canine tooth, which slowly and gradually increased in size until a year ago, since which time it has rapidly enlarged, without, however, causing any pain or real discomfort. During this period the canine tooth had gradually become displaced, and lay horizontally on the enlarged alveolar border. Four years ago patient had the second molar, on lower jaw, of left side removed, on account of toothache. He had no trismus, or difficulty in mastication, previous to seeing the dentist. Speech has been rather thickened during the past year. There is no specific history.

When first seen by the reporter, he was anæmic, and presented a rather uniform swelling of the lower jaw, extending from the anterior border of the masseter muscle on the right side to the angle of the jaw on the left.

There was no solution of continuity of skin over this area, or evidence of acute inflammation. The skin was smooth, somewhat tense, and movable.

The lower lip was swollen and pushed outward, the tongue protruded between the lips. He constantly dribbled saliva. He was unable to open his mouth beyond a space of 3 centimetres, and stated that he could not then masticate any food, and was living upon liquids.

On separating the lips, it was evident that the lower left canine tooth was missing; occupying its site was a circular opening, 1 centimetre in diameter; the remaining teeth of the mandible were apparently normal. There was considerable gingivitis along the whole alveolar border.

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[1] Read before the Medical Society, District of Columbia, May 17, 1905.

On the posterior aspect of the symphysis was felt a firm, resistant, bulging mass, destroying the normal contour of the bone, and extending in a direct line from molar to molar on either side. The anterior surface was compressible. The glands in the neck were not enlarged.

On insertion of a probe through the opening, left by the extracted lower left canine tooth, a cavity extending 4 centimetres to the right of the opening and 4 to 5 centimetres on the left could be mapped out. On the left side several smaller pockets or cavities were detected with the probe. Upon pressing the point of the probe, which was within the cavity, anteriorly towards the skin it met with no bony or shell-like resistance, and at any portion within the area of the cavity anteriorly the probe point could be distinctly outlined, demonstrating, anteriorly, destruction of the bone and periosteum.

At the extreme left lateral portion of the cavity denuded bone was felt. The anteroposterior width of the space was apparently about 3 centimetres.

Cultures were made from different parts of the cavity, but it was later found that infection from the mouth flora was too great to permit of any deductions being made therefrom.

Temperature in axilla, normal.

October 28, 1904, a mesial incision was made from the mucocutaneous border of the lip to the hyoid bone. The separation of the tissues disclosed an ugly looking necrotic cavity. The periosteum and bone substance on the anterior aspect of the mandible; above, from the alveolar margin to the protuberentia mentalis below, and laterally so far as the tissues of the wound could be extended on either side, showed complete destruction of periosteum and bone. Sufficient room not being obtainable by the mesial incision, the lip was cut through, and lateral incisions were made below the chin, to the anterior borders of the masseter muscles on either side, from the median incision, and the flaps reflected.

On the inner surface of the muscle of the reflected flaps were seen patches of necrotic periosteum adherent to infiltrated muscle tissue; these were carefully clipped away.

The mylohyoideus, geniohyoideus, and genioglossus muscles, with the periosteum, were then detached posteriorly, mucous membrane incised anteroposteriorly, the necessary teeth ex-

tracted, the jaw sawn through at the second molar on the right, and at the last molar tooth on the left side. The mucous membrane was brought together by running suture, thus closing the wound within the mouth. The detached mylohoid muscles were brought forward to the chin wound and sutured. There was practically no loss of blood during the operation. The anæsthetic was taken very badly.

Impressions were made by a dentist of the teeth remaining on the stumps on either side of the jaw,—two on the right and one on the left. From the impressions he made gold crowns, which were snugly fitted over the teeth; soldered to these crowns were two heavy strands of platinum wire bent to the shape of the mouth. Before application, this prosthetic measured from crown to crown 1 centimetre more than the space between the teeth; that is to say, a line drawn from the molar on the right, across the tongue to the molar on the left, was about 1 centimetre shorter than the prosthetic appliance. This acted beautifully as a splint and spring, gave no discomfort to the patient, and prevented any contraction towards the middle line by the stumps. It also prevented falling in of the lower lip and allowed perfect cleansing of the mouth and mucous membrane line.

At the end of four weeks the wire frame was encased in a hard rubber plate, which the patient is still wearing. This plate is grooved below in its whole length. An upgrowth of tissue is now taking place within the grooved space, which will give a firmer base for the plate, and later it is the intention to make a new plate, with teeth attached, for cosmetic and serviceable purposes. At present the patient gets along very well with the appliance as it is. He has no difficulty in removing and replacing the plate at will, so that it can be thoroughly cleansed (Figs. 1 and 2).

In operations of this character on the jaw, where a complete solution of continuity has been made, the difficulty has always presented itself as to the best method to overcome the inevitable contraction inward of the stumps, Lallemand[1] reports a case in which a space only 2 centimetres remained between the stumps after cicatrization of the attached muscles. Martin,[2] of Lyons; Fritszche,[3] Nux,[4] Stoppany,[5]

FIG. 1.—Showing result of removal of dentigerous cyst of mandible; prosthetic appliance held in hand.

FIG. 2.—Showing result of removal of dentigerous cyst of mandible; profile view.

Partsch,[6] Sachse B.,[7] Bonneken,[8] and others have devised various so-called artificial jaws for overcoming defects left by displaced bone. The plan adopted in this case is simpler than any of the methods I have so far been able to find recorded, and is, in fact, the only case I know of where the prosthetic has been made and applied in this way. Its use is naturally limited. In a case where no teeth remain to which to attach crowns, it would of course be useless, but where indicated, it avoids the use of bolts, nuts, nails, etc., boring holes in the stumps, and leaving channels for mouth infection.

A bandage supporting the chin was kept on the patient during his stay in the hospital. He left the institution well two weeks after the operation.

I am indebted to Dr. J. C. Bloodgood, of Johns Hopkins, for a pathological report of the specimen, which is as follows:

Gross Pathological Diagnosis; Dentigerous Cyst of Lower Jaw.—There is a bone capsule present everywhere except anteriorly. Here the bone is absent, and there is an irregular opening about 3 by 4 centimetres.

The bone is very thin. In the single cavity there are bony partitions. There is an opening on the alveolar border corresponding to the extracted canine tooth.

In the cavity I can make out a definite connective-tissue lining which can be separated, leaving normal bone behind. There is in addition, on top of this membrane, a hæmorrhagic granular friable tissue that does not look like adamantine epithelioma, but somewhat like giant-cell sarcoma, or a partly organized bloody exudate.

Microscopic Study.—In a section of the cyst wall, 1 millimetre thickness, stripped from bone capsule, the wall towards the bone is composed of a myomatous connective tissue containing numerous blood-vessels. The surface of the wall is lined by a pretty thick layer of epithelial cells of the adamantine type. The basal cell has a spindle nucleus perpendicular to the basement membrane.

In the next layer the spindle cell in some places is perpendicular, in others parallel. The nucleus is still spindle. More superficially the cell assumes the typical stellate adamantine form. The nucleus of the cell in the superficial layer is round, the cell larger, and hardly takes the stain. Such is the degeneration seen in the adamantine epithelium beneath this epithelial lining; in places there is slight lymphoid cell infiltration and some polynuclear leucocytes.

In a section of the granular tissue within the cyst wall, the histology is about similar to that of the section already described. It is lined by the same adamantine epithelium, which is broken and de-

stroyed in places; the connective tissue is more vascular. There are large areas of hæmorrhage and organized blood-clot. There are no giant cells, no evidence of tuberculosis. The adamantine epithelial lining shows no atypical downgrowth.

Diagnosis.—Jaw, benign dentigerous cyst; lined by adamantine epithelium. The first case observed.

Note.—This is the first simple dentigerous cyst that I have observed to be distinctly lined by a layer of adamantine epithelium.

The histological picture above described, showing a distinct layer of adamantine epithelium on a dentigerous cyst membrane, would seem to add further to the proof of the conclusions of Malessez and Witzel, that the dentigerous cyst, cystadenoma, and adamantine epithelioma of the lower jaw all have one etiological factor to start from, namely, the so-called "débris epithéliaux paradentaire" of Malessez. It has also been shown that this débris remains in the bone substance of the lower jaw during adult life.

This case differs from the so-called adamantine epitheliomata and cystadenomata in showing no invasive or irregular appearance in its epithelial structure.

Here we have a distinct layer of adamantine epithelium without downgrowth or apparent malignant change. Probably ony temporary.

Steensland,[9] in his latest contribution to the subject, acquiesces in the conclusions of Malessez [10] as to etiology of the adamantine epitheliomata of the jaw. And Pincus,[11] in his article on "Centrale Kystadenone Keifer," states that all authors are agreed as to the conclusions of Malessez and Witzel [12] regarding the causation of these tumors. Cumston [13] also agrees in these views, giving Magitôt [14] credit for his earlier theories along these lines.

After a careful review of all the literature on the subject of tumors of the jaw, which is very extensive, I am unable to find a single case of so-called dentigerous cyst occupying the site of the tumor here presented. In every case so far recorded the tumor has been unilateral; in this case it will be observed that it was central, causing destruction of the symphysis, and extending to the molars on either side of the jaw.

It is also the only case of so-called simple dentigerous

cyst so far described in the literature of the subject that exhibits an epithelial lining on a dentigerous cyst membrane.

In only one instance do I find a somewhat analogous case, which is reported by Becker. In Becker's [15] case the tumor was median; it was a single cyst with wall from 1 to 2 millimetres in thickness and lined throughout with adamantine epithelium.

Pincus and Steensland group Becker's case among their reported cases of adamantine epithelioma, cystic, semicystic, and solid, of the jaw, which they collected from the literature of the subject.

In only four instances can I find it stated in the reported cases of cystadenoma and adamantine epithelioma of the jaw that the site is medium.

In the cases reported by Bloodgood,[16] of dentigerous cyst, adamantine epithelioma, and adamantine epithelioma in a dentigerous cyst of the lower jaw, the cases have all been unilateral as to location.

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A CONTRIBUTION TO THE KNOWLEDGE OF ENDOTHELIOMA AND PERITHELIOMA OF BONE.

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INTRODUCTION.—From time to time there have been reported cases of bone tumor showing certain peculiarities of structure which have served to separate them from the ordinary osteo- and periosteal sarcomata on the one hand, and the peculiar tumors or group of tumors classified as myeloma on the other. Such cases were reported in the sixties by Lücke, Kocher, and Billroth; in the seventies by Engelmann, Jaffé, Sudhoff, and others. To Hildebrandt (1891) belongs the credit of collecting these cases from the literature and giving a clear clinical and pathological picture of this affection. His work was based on eight cases, including one of his own. Volkmann (1895), in his exhaustive article on endothelial tumors in general, reported a case of endothelioma of bone, abstracted the previously reported cases, and analyzed the tumors according to their seat and histological structure. Volkmann's conclusions were based upon fourteen cases, one of which (Zahn's second) was evidently a myeloma and should be excluded. Including our own four cases, herewith reported, there are now twenty-three cases available for analysis and generalization. The present work consists in (1) An abstract of the previously

reported cases. (2) Report of four new cases. (3) Pathology of endothelioma and perithelioma of bone; (*a*) general pathology; (*b*) histology; (*c*) histogenesis. (4) Etiology. (5) Clinical history, diagnosis, and treatment.

The following cases classed as endothelioma or perithelioma primary in bone are to be found in the literature. The earlier ones have been already collected in the articles of Hildebrandt, L. Volkmann, and Gaymard, but they have not appeared in English:

CASE 1.—LÜCKE, 1866, reported the case of a woman forty years of age, who complained of lancinating pains and a swelling in the right arm, and on reaching to a high place developed a spontaneous fracture. An elastic tumor rapidly developed. The axillary glands were not invaded. Disarticulation at the shoulder; no recurrence after three and one-half years.

Tumor.—The tumor was covered with healthy skin and atrophied muscle. On section it was soft, of a red color, and contained a large cavity filled with bloody fluid. Microscopically there was a fine reticulum with blood-vessels, supporting bands, and gland-like columns of epithelial-like cells, many of which contained colloid material.

Origin in the marrow cavity.

CASE 2.—KOCHER, 1868, a male, aged sixty-six years, eight months after an injury developed a pulsating tumor, with a systolic bruit, of the frontal and temporal bones.

Under the impression that it was an aneurism the carotid was ligated. Pulsation disappeared but returned, when the growth was extirpated.

The tumor developed between the pericranium and the dura. Microscopically the tumor was very vascular and contained spaces lined with rows of cells and containing blood in their lumina. Marked hyaline degeneration. No metastases.

CASE 3.—BILLROTH, 1869. A male of middle age, with a pulsating tumor of the lower half of one tibia. Amputation. On section, the canal of the lower part of the tibia was filled by the tumor. Microscopically, the growth was very rich in thin-walled blood-vessels, and was composed of epithelial cells. Origin: The blood-vessels of the bone marrow; probably perithelioma.

CASE 4.—ENGELMANN, 1871. A male, forty-eight years old, developed a tumor of the sternum and ribs the size of a man's head. Multiple metastases of lungs and lymph-glands. The tumor was firm, encapsulated, and had cysts containing colloid material.

Microscopically, the tumor was composed of round and elongated alveoli and gland-like columns of cells, with colloid degeneration. En-

gelmann regarded the marrow cells as the origin of the tumors; probably endothelium of lymphatics.

CASE 5.—JAFFÉ, 1874. Male, aged twenty-four years. A pulsating tumor of the left iliac bone developed to the size of a pear in six months.

Partial extirpation; death.

The left iliac bone was extensively invaded by a tumor mass with an alveolar structure and many small cavities. Near the centre these were the size of a pea and red in color.

At autopsy, numerous metastases were found in the lungs and pleuræ. On microscopical examination, the tumor was very vascular and showed an alveolar structure, some of the spaces resembling acini. There were spaces lined with several rows of cylindrical cells and containing no blood-corpuscles.

Origin.—Jaffé thought the inner layer of the periosteum.

CASE 6.—SUDHOFF, 1875. Female, aged thirty-two years, complained of pain in the joints for three years. There was a tumor of certain of the spinal vertebræ and of the sacrum. Death from pressure-myelitis. At autopsy the seventh dorsal vertebra was swollen, the bodies of the twelfth dorsal and first lumbar vertebræ were softened and invaded with a grayish white marrow-like substance. From the tenth to the twelfth dorsal vertebræ a tumor mass compressed the spinal cord. The second, third, fourth sacral vertebræ, the sternum and left femur were also involved. The femur was the seat of a spontaneous fracture.

In structure the tumors were in some places composed of large cells, round or polygonal in shape, with single nuclei and arranged in large alveoli supported by a stroma of fibrous and elastic tissue. In other places the arrangement was tubular, with cylindrical or flat cells and containing a fine lumen.

The origin of the growth was thought to be from the vascular endothelium.

CASE 7.—SCHWEININGER, 1876. A large centrally situated "adenoid" sarcoma of the humerus (sex and age not given). Microscopically the growth showed a plexiform arrangement and gland-like tubules. The origin was thought to be from the endothelial cells of the blood and lymph vessels and lymph spaces.

CASE 8.—V. LUKOVICZ. Male, aged sixty years. For twenty-one months before coming under observation sciatic pain on the right side. When first seen he had a diffuse thickening of the upper part of the right femur. In a short time there developed a rapidly growing tumor of the upper third of the femur, with spontaneous fracture of the latter. Death occurred eight months after the first occurrence of the sciatic pain.

At autopsy there was found a large mucoid tumor which involved two-thirds of the shaft of the right femur. On section the growth had a spongy appearance and contained a number of cysts containing mucoid material. There was extension to the pelvis and metastases in the pleuræ.

Microscopically the tumor consisted of large and small cyst cavities lined with low cubical or cylindrical cells of the epithelial type. The

cavities contained mucus, as did some of the cells. The tumor apparently took its origin from the endothelial cells of the connective-tissue lymph spaces.

CASE 9.—KOLACZEK, 1880. Male, aged eighteen years. A large tumor of the upper part of the left tibia which had developed in five and a half months. The leg was very much enlarged; slight enlargement of the inguinal glands.

Amputation.—The greatest length of the tumor was 22 centimetres and the greatest width 30 centimetres. It consisted of a hard and soft part, the latter containing cysts. The firm portion showed the histological structure of a spindle-cell sarcoma, while the soft portion showed endothelial lined spaces containing no blood-corpuscles.

Origin.—Probably from lymph spaces and vessels.

CASE 10.—ZAHN, 1889. Female, fifty-three years old, had a tumor of the base of the skull with numerous metastases (vertebræ, ribs, and liver). Microscopically the tumor showed an alveolar structure with bands and tubules of epithelial-like cells, some of which showed colloid degeneration.

The tumor was thought to have its origin in the endothelium of the blood capillaries. A second case reported by Zahn (*Beitrage zur Geschwulstelehre, Deutsche Zeitschrift für Chirurgie*, 1885, No. 22), reported as a multiple myeloma, is included in Volkmann's list, but I think that, with the similar tumor of Rustilzky, it should be excluded.

CASE 11.—HILDEBRANDT, 1891. Male, forty-five years of age. In childhood he sustained a fracture involving the right elbow. Nine months before coming under observation he had pain in the right arm; six months before being seen there was swelling of the right arm, and fourteen days before there was a spontaneous fracture. Amputation at the elbow; no recurrence on discharge one month later.

The tumor, which involced the lower end of the arm, was nodular in places, but the joint was intact. There was a fracture of the bone at the seat of the tumor. The latter was the size of a child's head, soft, and on section was red in color, and contained a central cavity, the size of an apple, filled with reddish gray material. The tumor was very vascular. It extended to the periosteum.

Histologically the growth consisted of blood-vessels, usually capillaries, from the sides of which there were cylindrical cells arranged in regular rows, forming tubules. The vessels contained red blood-cells.

Origin.—Stated as the perithelial cells of blood-vessels.

CASE 12.—DRIESSEN, 1893. A male, aged seventy-four years, had pain in the left elbow for two or three years. On admission there was a small tumor of the upper end of the left ulna. The tumor was removed, and there was no recurrence fourteen months later. The tumor was egg-shaped and measured 6 by 4 centimetres, and was firm in consistency. In places it was white, and in others of a dark-brown color.

Histologically the tumor showed both alveolar and tubular arrangements. The cells lining the spaces were epithelial-like, cylindrical, oval, and polygonal in shape. The growth was well supplied with blood-

vessels and fibrous tissue. The tumor cells contained fat and glycogen. Driessen thought the tumor had its origin in the endothelium of the lymph spaces of the bone marrow. There was no apparent connection with the blood-vessels.

CASE 13.—SPIEGELBERG, 1894. Female, aged sixty-two years. No history was obtained. At autopsy there was widespread tumor formation in various bones; the tumors varied from a walnut to a fist in size. They evidently had their origin in the bone marrow. Especially large growths sprang from the right os ilii and from the right metatarsal bone. The ribs and sternum were extensively involved. A small metastasis was found in the spleen; the other organs were free from tumors.

Histologically the tumors showed a well developed fibrous tissue stroma marked in places by the presence of spindle-shaped cells. In this stroma there were large and small alveoli containing cells of the size of ordinary pavement epithelial cells with round, deeply staining nuclei. The cytoplasm stained well with eosin. The cells varied markedly in shape and size; some were the size of ganglion cells. The cells were arranged in rows and cylinders, and between some rows a definite lumen could be made out. Spiegelberg regarded the growth as an endothelioma developed probably from the lymph spaces. Spiegelberg alludes briefly to a second and apparently similar case, without giving, however, either clinical or anatomical details.

CASE 14.—VOLKMANN, 1895. Female, aged seventy years. Two years before admission she noticed a slow growing tumor the size of a walnut on the back of her head. Eighteen months later it began to grow rapidly and was quite soft. On admission there was a soft, elastic, fluctuating, pendent tumor the size of a child's head growing from the occipital region. At one part there was an area of ulceration. On pressure pulsation was felt. At the base one could feel a circular perforation of the skull.

The tumor was extirpated and found to spring from the bone. The dura was normal. Death ten days after the operation. Autopsy. No metastases. The tumor was soft, pale, and marked here and there by reddish areas.

Histologically the tumor presented a groundwork of a spindle-cell tissue, supporting numerous gland-like tubules lined with a single and in some places multiple rows of cylindrical cells which could not be distinguished from cylindrical epithelial cells. These cells had large oval nuclei situated at the base of the cells. Among these high cells there were some cubical and polygonal-shaped cells. The lumina of the tubules were in general round. Some contained colloid or hyaline material. The origin of the tumor was traced to the spindle-shaped cells of the bone marrow, only a portion of which is in relation with the blood capillaries. Volkmann concludes that the cells separated from the vessels to form columns and to develop into gland-like tubules with cylindrical cells.

CASE 15.—MARKWALD, 1895. A male, aged fifty-six years, was taken ill in the spring of 1893 with pains in the back, chest, and joints.

By December, 1893, he was weak, his head rested on his chest, and the abdominal vertebræ were bent backward and to the left side. The deformity increased, and the patient died July 2, 1894. At the autopsy nothing of special interest was found in the internal organs. The head and body were cut in sagittal section in the middle line. The brain and cord were normal. The bones of the skull showed a number of small, reddish-brown, soft, very vascular tumor masses. Similar new growths were present in the bodies of most of the vertebræ, in the ilium, and the long bones of the extremities and the ribs. In the latter the tumors were both periosteal and in the marrow. All the tumors appeared to be of about the same age.

Microscopically, the tumors were composed of a connective-tissue stroma rich in capillaries, with cell masses arranged in rows suggestive of carcinoma. The cells had large, round nuclei surrounded with a considerable amount of protoplasm. The cells often formed long rows. Many of the spaces contained blood. The tumors sprang from the endothelium of the small capillaries and were classed as an intravascular endothelioma. The tumor tissue was not circumscribed, but tended to spread.

Case 16.—Gaymard, 1898. Female, aged nine years. She always had had good health until some months before coming under observation. Five months later she fell from a carriage, striking her head. There was a fracture of the left hip at the trochanter, where a tumor mass was felt. Fifteen days after the fall a small tumor was discovered at the junction of the right frontal and parietal bones. This tumor was soft, and on excision had the appearance of human muscle. Diagnosis. Angiosarcoma of the upper end of the left femur with metastases in the skull. Operation. Excision of the tumor of the skull.

Histologically the tumor was composed of a net-work of vascular tissue, with a delicate connective-tissue framework limiting large alveoli, and between this framework and the vascular spaces containing red blood-corpuscles there were from five to ten rows of round or polygonal cells; thus, a vascular lumen, stratified rows of cells, then supporting connective tissue. Gaymard regarded the cells as endothelial in origin.

Case 17.—Ritter. A female, aged fifty-one years, had pain in the right leg for six months. Three months later there was a swelling of the right leg and foot. Examination showed a fluctuating, pulsating tumor connected with the lower end of the tibia. Operation at the knee-joint. The tumor was spindle in shape; it began 3 centimetres above the ankle-joint, and was 8 centimetres long and 19 centimetres in circumference. Just above the tumor there was an old fracture of the tibia. The periosteum was thickened over the tumor, which in places penetrated the former. On section the tumor was soft and juicy, and of a dark brownish red color. No bone was found in the tumor. No metastases were made out. The tumor was composed of a structure of rather large cells arranged in places in long single rows, in places in solid nests or cords of cells, and in other places, still, in larger and smaller spaces or cavities. In the last case the cells were large, oval,

round, or pointed, and rested against capillary vessels which often contained red blood-cells. There was no membrana propria. The large spaces which contained blood were round, oval, or tubular in shape, and often communicated. Their lining cells rested directly upon capillary walls. The cells contained large fat drops, and some a material staining brown with iodine. The protoplasm of the cells was granular. The nuclei were large and stained deeply.

Origin.—Stated as the perithelial cells.

CASE 18.—BERGER, 1900. Female, fifty-eight years old, was admitted to the hospital in November, 1898, with a pulsating tumor and spontaneous fracture of the upper portion of the left humerus. In the previous June she had transient pains in the lower extremities and pain and loss of use of the left arm. On admission there was a pulsating tumor, the size of a mandarin, in the inferior deltoid region. The neighboring glands were not enlarged, the heart and lungs were negative.

Diagnosis.—Pulsating angiosarcoma of the humerus. Amputation. About two weeks later there appeared a swelling of the left side of the face, which later involved the orbital and frontal regions. At the same time the pains in the lower limbs returned. Some months later a tumor developed in the upper part of the left thigh. In June there was a spontaneous fracture of the superior portion of the left femur. There was pain in the trunk, and on one occasion blood in the urine. The tumors increased in size and the patient was bedridden. The upper part of the humerus, except the head and surgical neck, was destroyed by the growth, which was limited by a capsule which was continuous with the periosteum and separated the tumor from the surrounding soft parts. The tumor was continuous with the medullary tissue of the bone, and was soft, friable, spongy, and of a red-wine color. It contained spaces filled with blood and dark clots.

On histological examination by Dr. Bezançon the tumor was found to be surrounded by a connective-tissue capsule rich in blood capillaries. The tumor proper was composed of alveoli with thin connective-tissue stroma supporting cells of varying size. The thin alveolar walls consisted mainly of blood capillaries from 9 to 10 microns wide, which anastomosed with the vessels of neighoring alveoli, which were sometimes cylindrical, sometimes polygonal, or even round when they were about a lumen. The cells were in the main rather large,—15 to 20 microns in diameter. The cells had clear cytoplasm which stained with neither acid nor basic stains. They contained a single central vesicular nucleus with little chromatin and a large nucleolus. No karyokenesis was observed.

Origin.—Endothelium or perithelium.

There was a marked likeness to the tumor reported by Gaymard.

CASE 19.—STERNBERG, 1901. Female, aged sixty-six years, had pain in the back and knees for fourteen days. She was anæmic and presented the clinical picture of pernicious anæmia, but no blood examination was made. She died two days after admission.

Autopsy.—The body was poorly nourished; no deformities of the

skeleton. The lungs, pleuræ, and heart were negative. The liver showed a number of small nodules. The gall-bladder and bile ducts were negative, as were all the other organs except certain bones. The right femur and humerus, on section, showed scattered, soft, grayish white nodules. The sternum, ribs, vertebræ, sacrum, and cranial bones showed similar nodules.

Sections of the tumors of the marrow of the various bones showed large round, clear, swollen cells with peripherally placed, half-moon or sickle-shaped well staining nuclei. The cell body had a finely granular border, while the inner part of the cell contained one or more vesicles or spaces (fat spaces). In some cells the cytoplasm was transformed into a large vesicle containing finely granular material. The cells were supported by a net-work of fine capillaries forming an alveolar arrangement. Giant cells were found in some places. The tumor cells contained no glycogen. No micro-organisms were found.

PERSONALLY OBSERVED CASES.

CASE 20. (Case I, HOWARD and CRILE.)—*Primary Perithelioma of the Left Humerus ending in Spontaneous Fracture; Non-union of the Fracture. Metastasis on the Tip of the Nose. Amputation of the Humerus and Tip of the Nose; Death on the third day.*

Clinical History (Dr. Crile). *Personal History.*—The patient was a well-built man, sixty-five years of age, and of a sturdy family without any history of malignant disease. He had always been active in business, and in his later years carried heavy responsibilities. There was no history of serious illness except several attacks of appendicitis.

Two years before the fracture of his humerus he fell down an elevator shaft for two stories without serious injury. He had been accustomed to drive a spirited trotting horse, even up to the time of the spontaneous fracture.

Present Illness.—For about two years prior to the fracture he suffered considerable pain in the humerus near the point of the fracture. The pain was not influenced by the weather, exercise, or by pressure, neither by treatment. While tossing a tennis ball preparatory to serving, his arm suddenly snapped and fell helplessly by his side. A temporary dressing was applied by Dr. N. C. Varian, after which he was under the care of his physician, Dr. C. B. Humiston. The fracture was transverse and was easily kept in place. There was nothing unusual in its clinical course excepting the tardy repair On the second and third weeks there

was a fairly good callus, but later this diminished and almost disappeared. At this time I became associated with Dr. Humiston. The tumor of the nose was such as to give the end of that organ the appearance of a greatly exaggerated tippler's nose,—red, tuberous, elongated, and slightly turned up.

On close inspection the numerous blood-vessels increased in density towards the tip, and faded out upward and laterally. There was neither pain nor tenderness. On palpation a distinct pulsation could be made out.

A diagnosis of angiosarcoma was made; a section, under local anæsthesia, was removed and submitted to Dr. W. T. Howard, Jr., who returned the diagnosis of perithelioma.

The fracture was believed to be due to a similar process in the humerus. At the end of eight weeks the humerus at the point of fracture showed pulsation.

Dr. Humiston, assisted by Dr. Hain, Dr. Fitzgerald, and myself, performed the operations.

The patient bore the operations well, but developed some obscure pulmonary symptoms on the third day and died rather suddenly. No autopsy was made.

The arm and the nose were submitted to Dr. W. T. Howard, Jr., for pathological investigation

Pathological Report (Dr. Howard).

(*a*) Small portion of tissue removed from the tip of the nose by Dr. Crile for microscopical examination. The specimen consisted of a small piece of skin and underlying tissue.

On microscopical examination the epidermis was found unbroken, somewhat thinner than normal, but otherwise unchanged. Beneath the skin and entirely unconnected with the epidermis there were a number of large capillaries and blood sinuses of varying size, surrounded by from one to three or four rows of large oval or polygonal cells with faintly staining vesicular nuclei, which usually contained nucleoli. Many of the nuclei showed mitoses. The outlines of most of the cells were very distinct; the cytoplasm was often vacuolar and sometimes finely granular. In many cells it was very obscure. The new growth was not encapsulated and extensively invaded the surrounding tissue. A diagnosis of endothelial hæmangiosarcoma was made, and immediate operation for the growths of both the nose and the humerus advised.

(*b*) On November 21, the tip of the nose and the left upper extremity of this patient were received at the laboratory.

Nose.—The specimen consisted of the end of the nose, including both alæ nasi, and measured 3 by 3.5 centimetres. At the tip there was an elevated tumor nearly round in outline and projecting from 8 to 12 millimetres above the surrounding skin. At one portion there was a small area of ulceration, and at another a globular protuberance .5 centimetre in diameter.

On section the tumor was 1.5 centimetres wide and 8 to 10 millimetres in depth, and of a grayish pink color. Its margins were irregular. At one point the tumor approached but did not invade the cartilage of the nose. The skin and underlying tissues were otherwise unaffected.

Portions of tissue were hardened in Orth's and Zenker's fluids and in alcohol, and stained with hæmatoxylon and eosin, eosin and methylene blue, and Weigert's elastic tissue stain. Sections through the whole growth showed that it was covered with unbroken skin, except at one point where the epidermis was entirely lost; the underlying tissue was infiltrated with red blood-cells, leucocytes, and plasma cells. At this point the tumor was from 1 to 2 millimetres beneath the surface, from which it was separated from the necrotic and infiltrated dermis by a thick layer of fibrous tissue. The new growth was in no way connected with the epidermis or the glands of the skin. It was surrounded by a rather dense fibrous tissue which it infiltrated on all sides. The tumor was separated into a number of well defined but irregularly oval areas by dense, white fibrous tissue bands, which were poor in nuclei and blood-vessels. The new growth was composed of a large number of capillary and venous spaces containing red corpuscles and lined by from one to four or five or more layers of large, round, oval, or polygonal cells with faintly staining nuclei. Here and there were larger and smaller spaces without visible lumina filled with large, flat cells like endothelial plates. Large blood sinuses lined with a single or double row of cells were numerous. No elastic tissue was found in the tumor.

Arm.—The specimen consisted of the left upper extremity. The forearm, hand, and fingers were normal. The arm measured 54 centimetres in length. In its middle third there was a tumor involving the whole thickness of the humerus, the periosteum and a portion of the muscles for a distance of 10 centimetres.

The skin was normal. The tumor was 15 centimetres in its greatest diameter. The muscles were irregularly invaded, the periosteum could not be made out, and a few spicules of bone represented the remains of the shaft of the humerus throughout the extent of the tumor. The marrow cavity, as well as the bone, periosteum, and muscles, was transformed into a homogeneous, pale, grayish-red tissue of a soft spongy consistency. A small amount of blood escaped on section. There were no cysts. The edges of the bone at the upper and lower borders of the growth were rough and irregular, but firm. The new growth invaded the marrow cavity for some distance above and below the main portion of the tumor. The head of the humerus was normal. The elbow-joint contained a small amount of clear fluid. Cultures from the tumor remained sterile.

Small pieces were cut from the various portions of the new growth, and from the humerus and its bone marrow and hardened in Zenker's and in Orth's fluids. Sections were stained with hæmatoxylon and eosin, methylene blue and eosin, with and without Weigert's elastic tissue stain, and with Mallory's connective-tissue stain.

The new growth was composed of a groundwork or supporting tissue, of sometimes thin and sometimes thick branching bands of rather dense, white fibrous tissue. In some places, especially where the growth was invading neighboring tissue, the supporting tissue had a hyaline, homogeneous appearance and contained relatively few elongated nuclei. No elastic fibres were found in this tissue.

The essential structures in the new growth were, however, numerous capillaries and sinuses of varying size containing a varying number of red blood-cells. These spaces were lined with from one to five rows of round, oval, or polygonal cells, with faintly staining and often vesicular nuclei, which often contained nucleoli. Nuclear figures were plentiful.

The cell walls were very prominent, while the cytoplasm was often indistinct and did not take the eosin stain. It was commonly finely granular and often vacuolar. The cells were often arranged in regular rows like glandular epithelium, and in this case were commonly columnar in shape, with their nuclei situated at the end of the cell furthest from the lumen. The tumor cells varied from 8 to 15 microns in diameter.

The blood spaces varied greatly in width, some being filled by a single red blood-cell on edge, while others were from 20 to 30 or even 200 microns in diameter. In some places the growth was alveolar in structure, there being no lumina, but the spaces completely filled with cells of the endothelial type. There was rather free communication between the blood spaces, which varied from long tubules to round spaces. The tubular structures ran in various directions. On cross-section they closely resembled gland ducts lined with cubical or columnar epithelium. In many places, especially where several spaces opened into each other, typical papillary processes were seen. They were composed of a thin layer of supporting fibrous tissue, covered with a single layer of cells.

The absence of a membrana propria was striking, the cells being in direct relation with capillary walls or with the supporting connective-tissue bands. A capillary could usually be traced between the neighboring or adjacent tubules or alveoli, the cells of which abutted the vessel. The spread of the new growth could be readily traced from the cells lining the blood spaces. In many places at the margins of the growth single and double rows of these cells could be traced making their way far out into the neighboring tissue. All gradations could be made out between these cells and the tumor cells. While the relations of the new growth to the capillaries were intimate, positive proof of the origin of the tumor cells from the vascular endothelium was not obtained. The new growth could not be traced to the lymphatic structures, either. The tumor is therefore in all probability to be classed among the so-called peritheliomata whose histogenesis will be discussed later. As the growth advanced, the surrounding tissue, whether bone marrow, bone, periosteum, muscle, or connective tissue atrophied and was infiltrated. The head of the humerus was not invaded. No newly formed elastic tissue was found in the tumor.

A small amount of blood pigment was present in the tumors of both nose and bone. Tests for glycogen were negative.

These growths were identical in structure. From the clinical history and the study of the tumors there is little doubt but that the nasal tumor was a metastasis for that of the humerus. It is much to be regretted that an autopsy was not granted.

CASE 21. (Case II, HOWARD and CRILE.)—*Primary Peri-*

thelioma of the Left Humerus with Metastases of the Left Temporal Bone, the Pleuræ, Lungs, and Liver. E. S.; male, aged thirty-one years; white; single; a patient at the Cleveland City Hospital, service of Dr. C. F. Hoover.

In January, 1899, he had a spontaneous fracture of the middle third of the left humerus. The bone apparently knit, but nine weeks later a second fracture occurred at the same place. Shortly after the first fracture the patient noticed a small nodule over the right temporal bone. He died of exhaustion, August 2, 1899, about seven months after the first fracture of the humerus.

Autopsy.—The body was markedly emaciated. The middle third of the left humerus was the seat of a large, soft, grayish red tumor. Occupying the space between the left orbit and the left ear there was a large tumor the size of an orange. The latter growth was continuous with the temporal bone, which was soft and friable. This tumor was soft, grayish-red in color, and quite vascular. The surface of the body and the other bones as far as could be determined were free from metastases. Metastatic nodules from 2 to 10 millimetres in diameter occurred in both pleuræ, both surfaces of the diaphragm and in both lungs, and on the superior surface of the liver. The bronchial glands and mediastinal tissue were extensively invaded. The other organs were without present interest.

Histological examination of bone tumor. Sections made from various parts showed very much the same appearances. The bone tissue was largely replaced by a new growth composed of a fibrous tissue stroma which, in general, was quite thin, often consisting mainly, and sometimes entirely, of single narrow blood capillaries, forming alveolar spaces, which were filled with cells of varying shape and size. In most places the cells lay in direct relation with the capillary walls, which to a great degree formed the boundaries of the alveolar spaces. The latter were round or oval in outline and from a few to 200 or 300 microns in diameter. The cells were from 8 to 16 microns in diameter, and were round, oval, or polygonal in shape. Often they formed large flat plates like endothelial cells. They were often placed in long rows, but only occasionally could a lumin be made out. No columnar cells were found. Many giant cells were present in some places. The cells had large, oval, vesicular nuclei, each with a nucleolus. The

cytoplasm was finely granular and stained well with eosin. The cells were intimately connected with the capillaries. The bone disappeared before the advancing growth. This tumor in structure is a typical example of the so-called perithelioma of Hildebrandt.

The metastases of the pleuræ, lungs, and liver showed a structure identical with that of the original tumor.

Diagnosis.—Primary so-called perithelioma of the left humerus with metastases of the left temporal bone, the pleuræ, lungs, and liver.

CASE 22. (Case III, HOWARD and CRILE.)—*Primary Endothelioma springing from the Lymph Spaces and Channels of the Lumbar Vertebræ, Clavicle, and Ribs, with extensive Metastases. Chronic Cholecystitis with Gall-stones and thickening of the Gall-bladder.* I. M.; male; white; aged forty-five years, entered the Lakeside Hospital, service of Dr. Edward F. Cushing, June 16, 1901, complaining of pain in the left side and back. His family history was negative. He denied syphilis and gonorrhœa. He had always been well until seven weeks before admission, when he was taken ill with pain in the abdomen, left side, and back. His bowels were constipated. The pain was worse at night and ran up and down the back. He was treated by his physician for lumbago. He said he passed less urine than formerly. The patient recalled having had a fall on January 1, 1901, but says he felt perfectly well afterwards until the present illness.

On admission, examination of the heart, lungs, liver, and abdomen were negative. There was no disturbance of the sense of temperature. The spinous processes of the third and fourth lumbar vertebræ were more prominent than normal, and pressure on the lumbar muscles caused great pain. Turning in bed and walking were accomplished with difficulty. In walking, the legs were dragged along with a shuffling gait. In stooping, the back was held rigid. When the head was tapped, sharp pain was felt in the lumbar region.

The urine was clear, of an amber color, sp. gr. 1030, acid, free from sugar. No albumen (albumose not recorded). No casts, a few leucocytes. The patient ate little and steadily declined. On July 5 a small subcutaneous nodule was noticed on

the right side just below the ribs in the posterior axillary line. Later, a similar nodule appeared on the opposite side.

On July 20, a painful swelling of the sternal end of the left clavicle was noticed. Blood examination, July 17, showed leucocytes 10,000 per cubic millimetre; hæmoglobin, 89 per cent. July 21, the leucocytes were 22,000 per cubic millimetre. The patient died July 29, 1901, after having been comatose for three days.

Autopsy two hours after death.

Abstract of the autopsy protocol. The body was 165 centimetres long and very much emaciated. On the left sternoclavicular articulation there was a well-marked tumor mass. The joint was movable and crepitant. Small subcutaneous nodules were present on the chest, abdomen, back, and left buttock. On section they were firm, translucent, and glistening. The sternum, costal cartilages, and mediastinum were negative. The tumor of the left clavicle was firm and translucent and grayish-white in appearance. Similar masses were present in the third and fourth ribs of the right side.

The bodies of the third and fourth lumbar vertebræ were softened and cut with comparative ease; the bone tissue was almost entirely replaced by a grayish-white translucent tissue. The body of the second lumbar vertebra contained an oval nodule 2 by 12 centimetres in diameter, and of a similar appearance. The bodies of the third and fourth lumbar vertebræ were flattened, the periosteum thickened, and in places extensively involved in the tumor tissue. This was especially well marked on the posterior surface of the bones where the tissue was soft and readily compressed. The spinous and transverse processes of the third and fourth lumbar vertebræ were thickened and extensively invaded with tumor tissue. A mass of tumor tissue, 2 by 1 by 1.5 centimetres projected from the spinous process of the third lumbar vertebra into the spinal canal and compressed the cauda equina. The dura was not affected, but the canal contained a large amount of clear fluid. A similar but smaller mass was found opposite the fourth dorsal vertebra; the cord was not compressed at this point. The left psoas muscle, near the bodies of the second and third lumbar vertebræ, was the seat of an irregular tumor mass 3 by 2.5 centimetres in diameter. On section this mass was found to be directly continuous and identical

in structure with the new growth of the vertebræ. As far as could be determined, no other bones were affected. Examination of the brain was not allowed.

The vascular system showed nothing abnormal. A few small nodular masses were found in both lungs. The peritoneal cavity contained 2500 cubic centimetres of greenish yellow fluid. The peritoneum over the intestines was studded with numerous small pale elevated nodules. The liver weighed 1650 grammes. The surface was covered with numerous pale elevated areas from 0.25 to 0.5 centimetre in diameter. The ligaments were thickened and contained similar nodules. On the extreme right border of the liver there was a firm nodule 5 x 3 centimetres. On section the organ was bile stained, and was studded with numerous brown or yellowish, firm, small areas which were sharply defined from the liver tissue. The lobules were visible. The bile ducts were dilated.

The gall-bladder was quite small and its walls very much thickened. On section the walls were dense and firm, the cavity much reduced in size, and contained fifty-five yellowish-brown stones. The mucosa was red, but showed no special thickening and no evidence of tumor formation. The hepatic duct was dilated, the cystic and common ducts normal.

The lumbar, mesenteric, gastrohepatic, peripancreatic, and bronchial lymph-glands were large, firm, and translucent on section. They were extensively invaded by metastatic growths.

The other organs are without present interest.

The tumor was evidently primary in the lumbar vertebræ (possibly the ribs and clavicle), whence metastases occurred by extension into the surrounding tissue (psoas muscle), thence to the lumbar and mesenteric and other lymph-glands, the peritoneum, liver, and lungs.

The macroscopical resemblance of the tumors to carcinoma was striking.

Histological Examination.—Sections of the bones. Bodies of lumbar vertebræ. Sections from the centre of the growth show dense, fibrous tissue stroma rather scantily supplied with blood capillaries containing a variable number of spaces filled with large cells. The cells in places formed long rows, sometimes single, but usually double or even treble. In other places there were round or oval alveolar spaces filled with cells. No lumina

were to be seen. Between the cells, both in rows and in alveoli and the stroma in most places, a definite row of thin flat cells in all respects like the endothelial plates of lymph spaces and vessels could be seen. In a number of instances the development of these lining cells into the tumor could be traced; this occurred by the swelling of both nuclei and cytoplasm, with the transformation of the thin plates into large cells, with swollen vesicular nuclei. The tumor cells varied very much in size, from that of a polymorphonuclear leucocyte to huge multinuclear giant cells. They were usually polygonal, but sometimes round, often oval, and in many cases, especially when lying in single rows in narrow lymph spaces, very much elongated. In general they were large cells. The cytoplasm was smooth or finely granular, and stained faintly with eosin. The nuclei were large and vesicular, with well-marked rims, and contained one or more nucleoli. In many of the large cells from three to six nuclei could be made out. Nuclear figures were numerous. Nuclear and cell inclusions were not uncommon. In sections at the advancing border of the growth in bone the origin of the tumor from the endothelium of the lymph spaces and vessels, especially the perivascular lymph spaces, was evident. Here in the soft bone marrow large alveoli of tumor cells were numerous. Following the proliferation of the endothelial cells of the lymph spaces and lymph vessels there was a growth of dense fibrous tissue. The advancing border of the growth was much more cellular and softer than the older portions. With the growth of the fibrous tissue, stroma resorption of bone occurred.

In sections made through the fourth lumbar vertebra and its periosteum and the surrounding tissue, the spreading of the tumor tissue to the latter could be clearly seen. Sections made from the new growths of the clavicle and ribs showed the same structure described in the vertebræ, except that a better opportunity was given for the study of the origin and spread of the tumor tissue, which could be readily traced from the endothelium of the lymph spaces and lymph vessels, especially from the perivascular lymph spaces.

Lymph-glands, mesenteric and bronchial. In the sections studied, the lymphoid tissue was almost entirely replaced by a new growth made up of large and small alveoli filled with large

cells with large vesicular nuclei. Nuclear figures were numerous. No tubular formations were found.

Liver.—Scattered throughout the liver there were a large number of small metastases situated near the portal systems. They showed the same structure as elsewhere, but the tumor cells were crowded together more closely than in other organs. The liver-cells in many places were shrunken, compressed, and contained a large amount of pigment. In the portal systems which were not involved in the tumor metastases, the bile ducts and the portal connective tissue contained a considerable amount of bile pigment.

Sections of the gall-bladder showed desquamation of the lining epithelium, with dilatation of many of the glands and desquamation of the glandular epithelium. In many places the glands were absent. The wall of the gall-bladder much thickened by the presence of a dense fibrous tissue with scattered areas of round-cell infiltration. No tumor was to be made out, though numerous sections from various parts were examined.

Lungs.—In sections of the lungs the metastases were found mostly above the small bronchi, involving the pulmonary vessels, the peribronchial tissue, and often groups of tumor cells were found in the alveoli. In some places subpleural metastases were found. The pulmonary metastases showed the same structure as the original tumor and the other metastases.

Sections of the omentum showed extensive metastases always along the lymph channels and spaces.

Heart.—Sections of the heart muscle (left ventricle) showed a small metastasis. The spleen and pancreas were negative. The kidneys were the seat of chronic interstitial nephritis.

A study of the gross and microscopical lesions showed clearly (1) That the lumbar vertebræ were the primary seat of the new growth; (2) that the tumor spread first through the vertebræ to the surrounding tissue, thence by the lymphatics to the lumbar and mesenteric lymph-glands, the omentum, the peritoneum, and the hepatic lymph-glands; thence to the liver, lungs, heart, clavicle, and ribs. (3) The new growth was an endothelioma springing from the endothelial cells of the lymph spaces and vessels of the lumbar vertebræ.

Anatomical Diagnosis.—Primary endothelioma of the third and fourth lumbar vertebræ, with metastases in the perivertebral

tissue, the left psoas muscle, the lumbar, mesenteric, and bronchial lymph-glands, the omentum, peritoneum, liver, lungs, heart, clavicle, ribs, and sternum. Slight fibroid tuberculosis of the lungs. Chronic cholecystitis, with gall-stones, and thickening of the gall-bladder. Cultures from the lungs showed Staphylococcus pyogenes aureus and Bacillus mucosus capsularis,—other organs negative.

CASE 23. (Case IV, HOWARD and CRILE.)—*Primary Lymph Endothelioma of the Left Femur, with Metastasis in the Inguinal Lymph-Glands. Autopsy not obtained.*—Female, aged eleven years. Consulted Dr. Costello, July 15, 1901, complaining of pain in the left femur just above the knee-joint. There was no history of tumors in her family. The father and mother and several brothers and sisters were well. No history of tuberculosis or syphilis was obtainable. The child had had both measles and scarlatina. The child walked into Dr. Costello's office with a slight limp. There was no increase of pain on walking, bending the knee, or on pressure. On percussion there was deep-seated pain. There was slight symmetrical swelling of the left thigh just above the knee. Pulsation was not noted. On questioning the child, she stated that about June 1 she had a fall while playing in the school-yard. Examination by Dr. Costello showed a small abrasion of the skin below the point of swelling. There was no noticeable enlargement of the inguinal or other lymph-glands. The temperature was 99° F.; the pulse normal. *Diagnosis.*—Osteomyelitis.

Operation, July 17, by Drs. Gallagher and Costello. A longitudinal incision was made through the skin and soft parts, about five inches in length, on the outer surface of the left femur, at the point of swelling, and extending through the periosteum. The subcutaneous tissue was entirely normal in appearance. The periosteum appeared somewhat thickened, but not noticeably congested. The bone was firm but appeared thickened. About a teaspoonful of puriform(?) material was obtained from the marrow cavity. The wound was packed with gauze. There was no discharge of pus. About two or three weeks after the operation there was a slight uniform swelling of the lower end of the thigh. Very exuberant granulations formed in and about the sinus which persisted six weeks after the incision. The thigh became progressively larger, until by November it was the size

of a bucket, the swelling being uniformly round in outline and extending from the knee to near the hip-joint. The inguinal glands became swollen and tender, but no other glands were involved, and no other tumors were apparent. There was no pulsation of the tumor. Springing from the seat of the incision there developed a globular tumor mass the size of a man's head and uncovered by skin over a considerable area. Pain was marked. There was no fracture. She was seen by Dr. Crile in consultation in November.

Sections made from the piece of tissue excised by Dr. Crile showed a dense fibrous tissue stroma supporting occasional strands and alveoli of cells. Many alveoli were large and contained thin elongated cells. Some of the cellular strands were quite long.

The cells were large, of the endothelial type, and had rather large nuclei. Many of the cell collections were evidently in lymph spaces, from the lining cells of which their origin could be readily traced. The alveoli were evidently formed by the multiplication of the endothelial cells of these spaces. The blood-vessels took no part in the new growth.

GENERAL PATHOLOGY.

(*a*) Analysis of the 23 known cases shows as follows:

Seat.—Long bones were involved in 19 cases (humerus 7, tibia 3, femur 8, ulna 1); all the long bones, 1, flat and spongy bones in 15 cases (most of skull bones 1, base of skull 2, temporal and frontal bones 2, iliac bone 2, sternum 4, vertebræ 4).

Size.—The tumors were large in 11 cases, of moderate size in 7, and small in 5 cases.

Thirteen were said to be soft, 5 hard, and 5 elastic.

On section, the prevailing color was red or gray red.

Cysts of varying size, usually containing bloody fluid, were found in 8 cases. Of the 16 cases involving the long bones, spontaneous fracture occurred in 7.

In most cases the growth started in the central portion of the affected bone, spread along the marrow cavity, through the bone, and in several cases into the surrounding tissues.

The tumors were quite vascular, and several of the older cases were mistaken for bone aneurisms; seven were said to pulsate.

tissue, the left psoas muscle, the lumbar, mesenteric, and bronchial lymph-glands, the omentum, peritoneum, liver, lungs, heart, clavicle, ribs, and sternum. Slight fibroid tuberculosis of the lungs. Chronic cholecystitis, with gall-stones, and thickening of the gall-bladder. Cultures from the lungs showed Staphylococcus pyogenes aureus and Bacillus mucosus capsularis,—other organs negative.

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GENERAL PATHOLOGY.

(*a*) Analysis of the 23 known cases shows as follows:

Seat.—Long bones were involved in 19 cases (humerus 7, tibia 3, femur 8, ulna 1); all the long bones, 1, flat and spongy bones in 15 cases (most of skull bones 1, base of skull 2, temporal and frontal bones 2, iliac bone 2, sternum 4, vertebræ 4).

Size.—The tumors were large in 11 cases, of moderate size in 7, and small in 5 cases.

Thirteen were said to be soft, 5 hard, and 5 elastic.

On section, the prevailing color was red or gray red.

Cysts of varying size, usually containing bloody fluid, were found in 8 cases. Of the 16 cases involving the long bones, spontaneous fracture occurred in 7.

In most cases the growth started in the central portion of the affected bone, spread along the marrow cavity, through the bone, and in several cases into the surrounding tissues.

The tumors were quite vascular, and several of the older cases were mistaken for bone aneurisms; seven were said to pulsate.

Metastases occurred in over one-half the cases (14).

In 8 cases the tumors were single and without apparent metastases.

In the 13 cases in which multiple tumors are known to have been present, in only 4 were the bone tumors single. In these 4 cases (Engelmann, Jaffé, von Lukovicz, our Case I), the lungs and pleuræ showed metastases in 3, the primary growths being in the sternum and ribs, left os ilium, and left femur each in 1 case; in the fourth case a primary tumor of the left humerus gave rise to a secondary growth on the nose.

In the remaining cases there were multiple growths in several bones, with metastases in some of the internal organs in 4.

A synopsis of these 9 cases shows as follows: Sudhoff's case, multiple tumors of the dorsal, lumbar, and sacral vertebræ, sternum, and left femur; Spiegelberg's case, right os ilium, a metatarsal bone, sternum and ribs; Marchwald's case, skull, most of the vertebræ, ossa ilia, ribs, and long bones of the extremities; Gaymard's case, left femur and skull; Berger's case, left humerus and femur and the skull (frontal bone); Sternberg's case, right humerus and femur, the sternum, ribs, and several vertebræ; Zahn's case, skull, vertebræ, and ribs; our second case, left humerus and the skull (left temporal bone); our third case, the lumbar vertebræ, clavicle, and ribs. Certain bones were affected with great frequency, the bones of the skull, the vertebræ, the sternum, the ribs, and the femur being the ones most often involved.

Certain combinations of bones stand out prominently; for instance, the skull, the vertebræ, and the ribs, and sometimes the sternum being affected together. The humerus and the femur were simultaneously affected in two cases. In some of these cases it is pointed out in the clinical histories that the tumors apparently involved certain bones after others, but in some instances the tumors of the various bones appeared about the same time and were of apparently the same age. For some cases, at least, it seems not improbable that the tumors started in several bones at the same time, that is, that a number of independent malignant tumors of the same structure originated simultaneously in different bones. Opposed to this view are the fact that malignant tumors rarely originate in multiple foci and the probability that the bone tissue offered a more suitable soil for the growth

of wandering tumor cells than certain other organs to which the cells were also carried. In two of these cases the visceral metastases were inconspicuous, while in the remaining two cases they were wide-spread.

The other five cases of multiple wide-spread tumors of bones, like the myelomata, failed to show visceral metastases and the presence of tumors except in bone. Eleven cases are known to have died; in all but one of these an autopsy was obtained. The growth was rapid in nine cases. The growth of the tumors, when small and not involving the viscera, was associated in many cases with prostration and the usual symptoms of emaciation and cachexia. No special blood changes have been noted. Albumosuria was not mentioned in the histories of any of the cases, and was probably not looked for.

Histology.—The histological descriptions of the earlier cases are not very full, but a conformity to two general types is clear; (*a*) vascular tumors with alveoli filled with cells of various types, and (*b*) gland-like structures lined with single, double, or multiple rows of round, oval, polygonal, or even columnar cells of the epithelial type. In some tumors there were both alveolar and tubular structures. Giant cells may be present in both varieties. In both types the relation between the tumor cells and the blood capillaries is usually intimate and conspicuous. In many cases the tumor cells lie against the capillaries, which course between rows of the former. The blood capillaries may contain much or little blood; often they are compressed by the tumor cells. The alveolar walls are in many instances composed entirely of capillaries, while in others the tumor cells are supported by an abundant fibrous tissue stroma. The latter was especially well marked in our Case 3. The gland-like structures—tubular endo- and perithelioma—often form long tubules, and may contain blood. In some tumors the fibrous tissue was scanty, while in others it was plentiful and rich in nuclei and spindle-shaped cells. As far as is known, it is composed of white fibrous tissue. The tumor cells are prone to degeneration, and there are instances of fatty, colloid, hyaline, and myxomatous change. Ritter and Driessen demonstrated glycogen in the tumor cells in their cases. The iodine test for glycogen was negative in our Case 1.

Many of the tumors in bone were not sharply marked off from the marrow tissue. The histological structure is entirely

unlike that of myeloma, from which it is readily distinguished. The cells and their arrangement, however, differ rather widely, and this is readily understood when their diverse points of origin are considered.

(*c*) *Histogenesis.*—From analysis of the cases available at the date of his article, Volkmann concluded that these tumors had their origin as follows:

From the endothelium of the lymph sinuses, 4 cases (Lücke, Driessen, Engelmann, and von Lukovicz); from the endothelium of blood capillaries and the perithelial cells, 6 cases (Kocher, Kolaczek, Hildebrandt, Zahn, Jaffé, and Billroth); from the endothelium of lymph channels and blood capillaries, 2 cases (Schweininger and Volkmann); unclassified, 1 case (Sudhoff).

While we do not believe that it is possible to accurately classify these cases according to their histogenesis, a careful study of each leads us to think the following is approximately correct, and as near the truth as it is now possible to arrive. From the perithelial cells of Waldeyer, or the endothelium of perivascular lymphatics, 12 cases (Lücke, Kocher, Billroth, Jaffé, Hildebrandt, Gaymard, Ritter, Berger, Sternberg, and Howard and Crile, Cases I, II, and V); from the endothelium of blood capillaries, 2 cases (Zahn and Markwald); from the endothelium of the ordinary lymph vessels and lymph spaces, 7 cases (Engelmann, Kolaczek, von Lukovicz, Driessen, Spiegelberg, Volkmann, Howard and Crile, Cases III and IV); from the endothelial lining either of the blood capillaries or the lymph vessels, two cases (Sudhoff and Schweininger). If the above is correct, one-half of these tumors are perithelial in origin, while the other half are derived from either the blood or the ordinary lymph-vessel endothelium. The term perithelioma was first applied to certain of these tumors by Hildebrandt. That the tumors in question arise from the perithelial cells of Waldeyer, cells found in relation with the small blood-vessels of certain organs, notably the testis, is by no means proven. As Driessen points out, these cells have not been demonstrated about the blood-vessels of either bone or periosteum. Morphologically, the cells of these tumors are of the endothelial type, and like endothelial cells they lack apparently the property of secreting intercellular substance. Hence it is fair to conclude that they are not of the ordinary connective-tissue type. This being so, it is evident that the tu-

mors classed as peritheliomata must take their origin from either the endothelium of blood capillaries or from the endothelium of the perivascular lymph spaces.

That tumors of the same structure as the so-called bone peritheliomata may arise from the endothelium of blood capillaries, we have had recent evidence in an endothelioma of the breast removed by Dr. Crile, in which there were both closely filled alveoli and tubular structures often containing blood and corresponding exactly with the structure of the tumors of our Cases 1 and 2, which would be classed among the peritheliomata by Hildebrandt and others. In this breast tumor some of the blood capillaries were more or less completely filled with proliferated endothelial cells. In other places the mode of development of the tubular structures could be directly traced from proliferated blood capillary endothelium, the newly formed cells protruding from the capillaries, and forming short or long rows in the surrounding, but otherwise unchanged, connective tissue. The perivascular lymph spaces played no apparent part in the process. The presence of blood in the spaces of the so-called peritheliomata does not prove that these tumors spring from the blood-vessel endothelium, for its presence is readily explained by hæmorrhage, large areas of which are not uncommon; contrariwise, the absence of blood in the spaces cannot be taken as an argument against the blood-vessel endothelium as the origin of certain of these growths.

We are inclined to agree with the opinion of Driessen, Perth, Hildebrandt, and others that the so-called perithelium is in reality the endothelium of the perivascular lymph spaces.

We have not been able to make out in sections of bone marrow any cells which could be classed as the perithelial cells of Waldeyer. In the bone marrow the blood capillaries show no such cells, and are not accompanied by perivascular lymph spaces, which can, however, be made out about the small arteries and veins. Hence we would include among the so-called bone peritheliomata those tumors springing from these cells, as distinguished from the lymph endotheliomata derived from the endothelium of the ordinary lymph spaces and lymph vessels, *i.e.*, those not immediately about the blood-vessels. Judged by the study of our own material, derived from tumors of bone and other organs, it is not possible in most cases to decide whether

a given tumor springs from blood-vessel endothelium or perivascular lymph space endothelium (perithelia).

Apparently, there may develop from the endothelium of either of these two places growths of identical structure; that is, the endothelium of either situation may give rise to endothelial cell growths composed of either completely filled alveoli or of tubular spaces (with or without blood-cells in the latter) in which both alveoli and tubular spaces are separated and supported by blood capillaries in direct relation with the tumor cells. The chief difficulty in diagnosis here is due to the fact that growths developing from blood capillary endothelium may form alveoli by proliferation inside the vascular lumen, the alveolar boundaries being furnished by previously existing or newly formed capillaries, or the proliferating endothelial cells may break through the blood capillaries and form either tubular or alveoli structures. Unfortunately, these tumors are not presented for examination in their earliest stages, and one cannot say whether a growing portion of the tumor is derived from the cells of the vessels or spaces in which proliferation is taking place, or the proliferating cells are transported tumor cells from older portions of the growth.

At the present time we cannot certainly distinguish but two varieties of endothelioma of bone: (1) those derived from the endothelium of blood-vessels and perivascular lymph spaces, and (2) those springing from ordinary lymph vessels and spaces, and not immediately connected with blood-vessels. Of our own four cases, Nos. I and II belong to the first and Nos. III and IV belong to the second variety. These two varieties of tumor are characterized by unmistakable differences. The first, with their multiple rows of cells in alveolar or often in tubular arrangement, sometimes containing blood and always bounded by blood capillaries, stand out in marked contrast to the larger and smaller alveolar collections of cells which more or less completely fill the lymph spaces and lymph vessels from which their origin is so readily traced.

The second variety of bone endothelioma much resemble carcinoma in macroscopical and in microscopical appearances, and no doubt the cases of so-called primary carcinoma of bone belong to this group.

Borrman's division of these tumors into two classes—peri-

theliomata and peri-endotheliomata, the first with a radial perpendicular and the second with a concentric arrangement of many layered superimposed cells about the vessel walls—is of doubtful value. The endotheliomata of bone dealt with in this article are not to be confounded with the so-called tubular perivascular sarcomata, types of which are the cases recently reported by Low and Lund.

Of the single bone tumors forming metastases in the other organs, two, as said before, had their origin from the perithelium, and two from the endothelium of lymph-space vessels. The nine cases of multiple bone tumors had their origin as follows: perithelium or blood-vessel endothelium, 6; endothelium of ordinary lymph spaces and vessels, 2; blood or lymph vessels, 1. Both of the tumors thought to be derived from the capillary endothelium and four of the peritheliomata formed multiple bone tumors, and a majority of the peritheliomata showed multiple growths.

Etiology.—Sex is without much influence; 12 cases were in males, 10 in females, and 1 sex was not recorded. These tumors occurred once each at 9, 11, 18, 25, 31, and 52 years; there were 5 cases between 40 and 50, 5 between 50 and 60, and 7 cases over 60 years. A history of previous injury was obtained in 6 cases. Further than this nothing definite is known of the cause of these growths. Without wishing to lay too much stress upon the observation, we must say that in studying sections of our Case III we were impressed with the readiness with which the proliferation of the endothelium of the lymphatics would be explained by the assumption of the action of micro-organisms or their toxines. As was necessarily the case, pictures were seen which were quite similar to those seen in the lymphatics in typhoid and other processes as pointed out by Mallory. In this connection, it is also of interest to recall the observations of the proliferation of endothelial cells of lymphatics with the formation of tubules by v. Notthaft and considered by him due to an infection in a case of pseudo-leukæmia, and the conclusions drawn by Boivard by which he excludes tumor formation in his case of splenomegaly with proliferation of the endothelium of the lymph sinuses of the spleen, abdominal lymph-glands, and perilobular lymph channels of the liver. In our own case we were struck with the idea that had micro-organisms or their toxines acted on these endothelium of the lymph vessels and sinuses, identical

changes must have been produced. Micro-organisms and bodies which might be taken for them have not, however, been observed in these growths. It is to be hoped that the attention that endothelial cells are now receiving may soon throw some light upon the etiology of these growths.

Relation of endo- and peritheliomata to bone aneurisms. Pulsation of the tumors was noted in seven cases. Hildebrandt, who has carefully reviewed the subject of the relation of bone aneurisms and malignant tumors of bones, concludes that true bone aneurisms are rare, and that a pulsating bone tumor is to be regarded as malignant, probably sarcoma. Roughton, who has recently written on the subject, reaches the same conclusion.

CLINICAL (DR. CRILE).

The clinical history and aspects of endo- and peritheliomata of bone present in general a similarity to the general type of osteosarcoma. Certain differences and a few well defined distinctions are apparent on closer study. The number of cases collected (23), which for the purpose of a more minute analysis might readily be said to be insufficient, reveals in certain directions a persistence of a few distinct characteristics, so that a deduction from this compilation of the symptoms, course, and termination of these neoplasms may be fairly assumed to accord with their general clinical anamnesis.

Sex.—In the foregoing tabulation of endotheliomata of bone, the sex is given in twenty-two cases, of which twelve were males and ten females. This proportion is not in correspondence with that found by Gross in sarcoma of bones. In a collection of 149 cases of osteosarcoma, he found that men were by 17 per cent. more frequently affected.

Age.—In marked variance with sarcoma in general is the age at which endo- and peritheliomata of bone are found to occur. In ordinary sarcoma of bone, although no age is exempt, children and young adults are most frequently affected. Butlin states that young adults of both sexes, from fifteen to twenty-five years of age, are much more liable to the disease than persons at the extremes of age, while, according to Volkmann, osteosarcoma usually develop during the growth of the individual, most commonly about the twentieth year, very rarely after the fortieth. Gross, in a tabulation of 147 cases of osteosarcoma in which the

age is given, found that in 68 per cent. these tumors developed before the thirtieth year, and in 32 per cent. after that period. From his table it can moreover be ascertained that 85.7 per cent. of these growths occurred before the fortieth year and but 14 per cent. after that time. Paget, in a collection of nineteen cases of osteosarcoma of various bones, reports the following:

In five cases the growths occurred at the age of				10 to 20 years.
In nine	"	"	"	20 to 30 "
In four	"	"	"	30 to 40 "
In one case		"	"	40 to 50 "

To this table may be opposed that of bone endotheliomata, the comparison between the two from the similarity of numbers in both being the more striking. In a tabulation of the cases of bone endotheliomata with respect to age, one finds that:

In one case the growth occurred at the age of				9 years.
In one	"	"	"	11 "
In one	"	"	"	18 "
In one	"	"	"	25 "
In one	"	"	"	12 "
In one	"	"	"	31 "
In one	"	"	"	32 "
In four cases		"	"	40 to 50 years.
In three	"	"	"	50 to 60 "
In six	"	"	"	60 to 70 "
In two	"	"	"	70 to 75 "

In this tabular arrangement it is to be noted that but five cases, or 26.13 per cent. of bone endotheliomata, occurred before the age of forty and 14 cases, or 73.87 per cent., after that period, while in the table of osteosarcoma of Paget, 18 cases out of 19, or 95 per cent., are found to have developed before the fortieth year, and but one case, or 5 per cent., between the fortieth and fiftieth year. In Gross's collection of 147 cases, as already mentioned, 85 per cent. occurred before the fortieth year, and 15 per cent. after that period. In summary:

	Before the Fortieth Year.	After the Fortieth Year.
Paget's table (osteosarcoma),	95 per cent.	5 per cent.
Gross's table (osteosarcoma),	85 "	15 "
In endotheliomata of bone,	26 per cent.	73 "

As to the age, bone endotheliomata are at variance with osteosarcomata, and in accordance with carcinomata.

Cause.—In the majority of the cases there is no apparent cause. Among the cases in which the occurrence of trauma is mentioned in connection with the appearance of tumor is that of Kocher, in which a pulsating tumor with a systolic bruit developed eight months after an injury from a flail in the right frontotemporal region. In Hildebrandt's case, a male, forty-five years of age, the endothelioma was found in the lower part of the arm above a fracture of the right elbow which had been sustained in childhood. Similarly, in the case of Ritter, a female, fifty-two years old, bore the evidence of an old fracture of the tibia, above which was situated the tumor. In another case presenting primary endothelioma in the clavicle, ribs, lumbar vertebræ, the patient had sustained a fall six months previously. As a whole, injury cannot be stated to be an etiological factor of much importance.

Bones Affected.—The predilection of endotheliomata of bone like that of osteosarcoma is for the long bones of the appendicular skeleton. In the 23 cases collected, the exact position of the primary involvement is given in 20, in the other three cases a number of bones were found to have been involved, and the seat of primary origin is either not mentioned or could not be definitely determined. The various bones were affected as follows:

Humerus, 5 times; ulna, 1 time; iliac bones, 1 time; femur, 4 times; tibia, 3 times; head, 3 times; vertebral column, 2 times; sternum and ribs, 1 time; other bones, 3 times.

The appendicular skeleton was involved in 14 cases, the axial skeleton in 6 cases, a proportion of approximately 2.

1. In the appendicular skeleton the upper extremity was affected six times, the lower extremity eight times. Deducting the one case in which the iliac bones were the seat of the malignant growth, it is seen that the long bones of both the upper and lower extremity were equally affected. The single bone most frequently affected is the humerus, there being five cases out of 20, or in 25 per cent. Femur and tibia are next in the order of frequency, each being involved four times, or in 20 per cent.

In osteosarcoma the favorite seat of these malignant growths is the femur and tibia, with by far the greater preponderance in favor of the former, as can be gathered from the table of Gross. Out of 165 cases analyzed,

The femur was the seat of the disease in 67 instances.
The tibia " " " 46 "
The humerus was the seat of the disease in 25 instances.
The fibula " " " 13 "
The ulna " " " 7 "
The radius " " " 6 "
The radius and ulna were the seat of the disease in one instance.

Volkmann, in writing of osteoid or subperiosteal sarcoma, states that these growths are especially encountered in the knee ends of the femur and tibia, and Butlin says that central sarcomas attack the same bones as the subperiosteal variety, so that they may be considered in the same manner and order. He asserts that " the long bones of the lower extremity are much more liable to malignant disease than the long bones of the upper extremity; the femur and tibia are the most frequently affected of all the long bones, the tibia perhaps rather more often than the femur, while the fibula is very rarely attacked. The humerus comes next to the tibia and femur in liability to the disease; the radius is not often attacked, and the ulna so seldom that it is difficult to collect any number of cases of ulnar sarcoma. Treves gives his opinion to the effect that the bones of the lower extremities are more frequently attacked than those of the upper, probably on account of their greater liability to injury; and the lower end of the femur and upper end of the tibia are more commonly affected than the other extremities of these same bones probably for the same reason, that the knees are more often exposed to trivial injuries than any other parts of the lower limbs. In osteosarcoma it has been noteworthy that the part of the bone affected is the epiphyseal end. Senn remarks that " sarcoma is found most frequently in that part of the bone where the circulation is most active,—that is, in the epiphyseal extremities of the long bones, and in the inner layer of the periosteum, the cambium." Gross also states that sarcoma of the long bones evince a great predilection for the articular extremities, and the majority develop in the spongy tissues of the epiphysis. In periosteal round-celled sarcomas, however, the same writer says the shafts of the long bones are much more frequently affected than the epiphyses.

In endotheliomata a similar predisposition is apparent, the site of the neoplasm being for the most part near the articular or epiphyseal extremity of the bone, where the vascular distri-

bution is greatest. The exact position as given by the various authors is as follows:

Lücke	Humerus.	Middle.
Billroth	Tibia.	Lower half.
Schweininger . .	Humerus.	Not given.
V. Lukovicz . . .	Femur.	Upper third.
Kolaczek	Tibia.	Upper part.
Hildebrandt . . .	Humerus.	Lower end (near elbow-joint).
Driessen	Ulna.	Upper end.
Gaymard	Femur.	Upper end.
Ritter	Tibia.	Lower end.
Berger	Humerus.	Upper portion.
Crile	Humerus.	Middle third.
Crile	Femur.	Lower third.

The exact point of origin of the endotheliomatous tumors, not unlike osteosarcoma, is either from the medullary canal of long bones or the spongy tissues of flat bones, *i.e.*, central, or on the other hand from the periosteum, *i.e.*, subperiosteal. The great majority of cases are of the central variety. Such are the cases of Lücke, Billroth, Engelmann, Schweininger, Driessen, Volkmann, Berger, etc. Among the subperiosteal endotheliomata is to be noted especially the case of Jaffé. In Markwald's case, tumors of both the central and subperiosteal variety were found.

Symptoms: Pain.—The symptoms of osteo-endotheliomata are identical with those of all osteosarcomata. Pain in these neoplasms is neither constant nor present in all cases, its presence being dependent in most instances upon pressure on or on the involvement of a nervous trunk. It is for this reason variable in character, its onset, duration, degree, etc. Tanaka, in writing of the clinical symptoms of endotheliomata in general, states that these tumors usually pursue a painless course. In central endotheliomata there is probably more often pain than in the subperiosteal variety, it commonly preceding the appearance of the tumor for several weeks or months.

Tumor Formation.—The appearance of swelling or tumor formation makes itself evident at different stages of the disease. In central endotheliomata no enlargement or growth may be perceptible to either inspection or palpation, a spontaneous fracture from the erosion of bone giving the first indication of the probability of an existing neoplasm. In other cases, however,

an enlargement of the affected bone becomes apparent, and especially so in the subperiosteal variety, in which the tumor formation forms the first reliable clinical symptoms. When first appearing, the tumor is of small size, and in the great majority of cases is reported on as not having increased rapidly in size, usually only attaining the size of a child's head. Pupovac states that a slow growth is characteristic of endotheliomata. In certain cases, as in those of Lukovicz and Volkmann, the growths, after having been in a state of quiescence for some time, suddenly acquired a tendency to proliferate rapidly. In Lücke's case a rapid increase in the rate of growth occurred after the bone had spontaneously fractured.

Capsule.—The demarcation between the tumor and surrounding tissues is in most instances established by a capsule. In the central growths of osteosarcoma, this capsule is either bony, membranous, or partly bony and partly membranous, while in the subperiosteal tumors it is always membranous when present. In endotheliomata of bone, the capsule, when mentioned, is usually stated to have been of a fibrous nature. Hildebrandt, however, refers to a bony capsule in bone endotheliomata, which he states to be formed from the periosteum. The statement that such a bony capsule is a new formation is somewhat problematical, as in osteosarcoma it is known to be a resulting derivative from the expansion of the cortical portion of the bone. This expansion of bone is caused by the invasion of the malignant growth, the tumor being thereby encased in a bony shell. The membranous capsule is derived from the periosteum, and probably to some extent, also, forms other connective tissues in the near vicinity of the bone and atrophied portions of muscles. Its thickness at times characterizes its most distinct attribute, which tends to hold the growth of the tumor in abeyance. Capsule formation in all endotheliomatous tumors has been frequently observed. Kolaczek, in a collection of 78 cases of endotheliomata affecting all the various tissues, states that in over one-half of these a capsule was present. Nasse, in an enumeration of 31 cases of endotheliomatous tumors of the salivary glands, asserts that in but one case was the capsule absent. Volkmann also gives the capsule a prominent position in the description of these neoplasms. The capsulation of these tumors is clinically of great importance, as it limits the growth of the new formation, and

prevents early metastasis and general dissemination. When this investing membrane ruptures, the tumor may suddenly acquire rapid proliferative properties; the degree of its malignancy is thereby accordingly increased.

In their configuration these tumors correspond closely with the osteosarcomata in general, their contour being in part dependent on their situation and point of origin. In central osteosarcoma, whether situated on the epiphysis or diaphysis, a spherical or globular shape is usually found. In the subperiosteal variety, when situated on the shaft, a spindle-shaped enlargement has been more often noted when at or near the articular extremity, somewhat pyriform swelling. This variety, moreover, never enlarges the bone equally in all directions, but merely produces a swelling on one aspect, and little or none on the opposite side. In central sarcoma, the tumor formation may also affect only one side of the bone; but in other instances, the cortex of the bone becomes expanded from the pressure of the growth of the neoplasm, and it bulges out on all sides. Endotheliomata of bone conform in these characteristics with osteosarcoma. Similarly, also, in the character of their surface, which is usually smooth and even, although in certain instances it has been observed to have been lobed nodular or tuberous, as in the case described by Hildebrandt. At times all configuration is lost, and there results from the extensive infiltration of the contiguous tissue, as in one of our cases, a diffuse growth and somewhat general enlargement of the part.

Pulsation.—The occasional occurrence of pulsation in these tumors has in several instances, as in the case of Kocher, given rise to the erroneous diagnosis of aneurism. In this case not only was pulsation present, but also other symptoms pathognomonic of aneurism, viz., a systolic bruit compressibly of the tumor by both direct pressure, and especially upon compression of the carotid artery of that side. Ligation of the artery, moreover, caused a total disappearance of both the pulsation and systolic bruit, which persisted for twelve days, when a faint pulsation but no murmur again reappeared. In one of our own, and in other cases reported by Lücke, Jaffé, and Billroth, both a pulsation and systolic bruit were present. In other instances, however, while a pulsation is described, no mention is made of the systolic bruit or other murmurs. The great vascularity of these tumors in

which pulsation was noted probably explains this occurrence. (Cases of Kocher, Jaffé, Berger, etc.) In others, as in the case of Ritter, blood spaces which communicated with each other are especially remarked upon.

Spontaneous Fracture.—Spontaneous fracture was noted in seven cases out of thirteen, in which the long bones of the appendicular skeleton were affected. Three times it occurred in the humerus and three times in the femur, and in one case, that of Berger, both the humerus and femur spontaneously fractured, the latter being the seat of metastasis. As already stated, spontaneous fracture at times gives the first indication of the existing neoplasm. It may occur without any premonitory symptoms, being the result of an erosion or pressure atrophy of the bone caused by the growth of the tumor. Theoretically, spontaneous fracture should occur only in central endotheliomata, the subperiosteal variety of these tumors, for the reason that they extend in an outward direction, and do not tend to invade the bone, and seldom, if ever, give rise to its occurrence.

Metastasis.—While Gross found that in osteosarcoma, metastasis occurred in 40.06 per cent., we note that in bone endotheliomata it is reported on in 63.64 per cent. of the cases. The organs which are most liable to metastasis are alike in all sarcomata, the lungs and the various bones of the skeleton. The spleen, liver, and lymphatic glands are more rarely affected. The greatest predilection for metastasis from endotheliomata of bone seems to be the bony skeleton; thus, in fourteen cases in which metastasis occurred, the bones were affected nine times, the lungs four times, the liver three times, and the lymphatic glands twice, and the spleen but once.

Diagnosis.—The diagnosis of osteo-endotheliomata cannot during life, from a clinical stand-point, be definitely established, as these neoplasms, as has already been repeatedly mentioned, conform in their essential characteristics with the osteosarcomata. Hildebrandt says that these tumors show no clinical differences. Symptoms entirely pathognomonic of bone endotheliomata which would serve for a differential diagnosis between the two do not exist. Among the differential characteristics may be mentioned the age at which these respective tumors are liable to appear. In patients of over forty years, it is recalled, endotheliomatous bone formations are more common in those whose age is below this

period, while the reverse is the more common occurrence of endotheliomata; and the fact that numerically cases of osteosarcoma are more often found, however, counterbalances any value which may be attached to this distinction. The other symptoms, such as pain, their situation, rate of growth, nature, and configuration of the tumor, metastasis and cachexia either singly or collectively, do not clinically serve to more clearly elucidate the nature of the given growth, whether it be a sarcoma or endothelioma. From other affections with which they may be confounded, the differential diagnosis is the same as for osteosarcoma. These are carcinoma, aneurism, if pulsation and its other pathognomonic symptoms be present, other bony tumors and the various inflammatory diseases of bone, periostitis, osteomyelitis, tuberculosis, and syphilis. The diagnosis from carcinoma, even with a microscopical examination, is at times difficult, much the more so from the clinical stand-point. Aneurism, also, may in rare instances so resemble these malignant tumors that it is impossible to differentiate them. Hildebrandt and Klebs each mention a case which, from its gross appearance, was stated to be an osteo-aneurism, and microscopically shown to be an osteosarcoma.

Concerning the prognosis of bone endotheliomata, but little can be said, as the experience with the same has as yet been too scant. The prognosis may be stated as favorable in all cases in which an operative treatment can be safely instituted. In tumors of the vertebral column and in those of the base of the cranium, where incision cannot be made, the fatal course of the disease can avowedly not be arrested. Metastasis also renders the prognosis unfavorable. Tanaka says, regarding the prognosis, that it is only favorable in those cases in which it is possible to eradicate all of the diseased tissues. When a diffuse infiltration is present, the chances for a complete extirpation of the disease and an ultimate recovery are markedly increased. In such cases not only the parent growth has to be removed, but also all the metastatic processes which radiate from it and are found in the surrounding tissues.

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MALPOSITION OF THE APPENDIX AS A CAUSE OF FUNCTIONAL DISTURBANCES OF THE INTESTINE.[1]

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A NUMBER of patients upon whom I have operated for supposed appendicitis have been entirely relieved of their symptoms; yet upon examination no inflammatory conditions in the appendix have been found.

All these patients presented a similar syndrome of symptoms which resembled those occurring in the course of a mild chronic appendicitis, but were not sufficiently characteristic to warrant a definite diagnosis of that disease.

The following cases sufficiently illustrate the symptoms and the anatomical conditions:

CASE I.—A. A.; aged forty years; female; has had attacks of pain in the right lower quadrant of the abdomen for four years. The pain has never been severe, but has been rather an extreme discomfort. After a maximum of discomfort for two or three days there has been gradual improvement. There has never been marked tenderness. Occasionally there has been nausea with the pain, but nausea has not been a feature. There has not been a temperature worthy of note in any attack.

The attacks have been accompanied with constipation and intestinal gas. After the bowels act freely the pain diminishes. Between the attacks there has often been discomfort, with rumbling of gas. The patient is a very active, non-imaginative woman engaged in arduous charitable work. The attacks, while interfering with her work, have rarely confined her to her bed.

P. E.; well-nourished woman. The examination of the abdomen revealed a slightly movable right kidney. During the

[1] Read before the New York Surgical Society, April 12, 1905.

attack there was some distention of the caput coli with gas and slight tenderness at the region of the appendix, but no palpable mass.

Operation, September 10, 1901.—The appendix was of the third type (Treves), two and one-half inches long. The meso-appendix was very short, suspending the appendix and with it the cæcum well up under the ileocolic junction; at its attachment to the appendix it caused a sharp bend in that organ. At the point of bending the lumen of the appendix was somewhat narrowed. There were no signs of recent or old inflammation. On dividing the meso-appendix the cæcum straightened out away from the ileocolic junction. The appendix was removed.

The patient has been entirely free of her attacks since the operation.

CASE II.—W. S.; forty-seven years of age; male. Active business man, somewhat neurasthenic. Attacks for two years at intervals of one to two months.

The attacks have been characterized by gas pains in the right lower quadrant of the abdomen, with little or no tenderness. Diarrhœa has been present in several attacks. Constipation has never been a feature. The patient has found that relief has at once followed a free catharsis with castor oil.

The patient has himself made a diagnosis of appendicitis and demands relief.

The physical examination was negative except for a very slight tenderness in the appendiceal region during the attacks.

Operation was decided upon after observing several attacks, and the following conditions were found: The appendix was implanted at the axial end of the cæcum (second type of Treves); it was four inches long; its extremity was slightly bulbous; there was no stricture or sign of inflammation. The meso-appendix was short and suspended the end of the cæcum, as in the first case, up under the ileocolic junction. Appendectomy allowed the cæcum to regain its normal relation.

The operation has been followed by complete relief.

A number of the cases observed have resembled the ones just reported in the relations of the appendix and cæcum to the ileocolic junction, namely, being drawn up under it by a short meso-appendix.

Another relation of the appendix may be present as was found in the following case:

CASE III.—The patient, E. W., a nurse, thirty-six years old, had suffered for two years or more with constantly recurring pains in the right lower quadrant, but not of sufficient violence to keep her off duty. There had been no signs typical of inflammation. Operation revealed an appendix four inches in length of the third type of implantation and in the retrocæcal position, the end of the cæcum being rolled up under itself.

Operation in this case was also followed by complete relief.

The above cases are fair examples of others I have operated upon. In looking over the notes of ten of these, two were found in which there were well marked evidences of enteroptosis and two in which the right kidney was distinctly movable.

In most of the cases traction was exerted on the cæcum through the appendix by a short meso-appendix; in a few the cæcum seemed to be suspended by the appendix being adherent behind the colon. Evidences of inflammation of the appendix were either wholly absent or so trivial as to hardly be sufficient to explain the symptoms.

An explanation of this anatomical condition is found in the development of this part of the alimentary tract. It is well known that the cæcum in late intra-uterine life descends from a position immediately below the liver to its normal one in the right iliac fossa. The descent is due rather to an increase in length of the descending colon than to a dropping of the colon. As the length of the colon increases, its vessels must also increase proportionately or a folding of the gut will occur.

In the class of cases under discussion, this disparity of growth occurs, and a folding of the gut results at the junction of the cæcum with the appendix from an inadequate growth of the vessels in the mesenteriolum. As these vessels normally pass behind the ileocolic junction, the appendix is held up behind that point and through it the end of the cæcum. In many instances a sharp kink of the appendix occurs at the point where its main vessel reaches it.

In some of the cases it appeared as if a constriction of the ileum might readily occur by an overdistended cæcum and ascending colon drawing it down over the band produced by the short meso-appendix.

With such a mechanical relation of these structures, it would seem that the symptoms complained of by these patients could be caused in the following ways, namely, by the tugging on the appendix and meso-appendix produced by an overdistended or overloaded cæcum; by a partial obstruction produced either in the ileum or the colon by their bending over the fixed appendix; or possibly by interference with the circulation of the cæcum and ascending colon.

When we analyze the symptoms, we see that they are an evidence of functional disturbances rather than inflammatory conditions. Fever and marked tenderness are absent. The pain is more a sense of discomfort, and lacks the violent colicky character accompanying inflammation of the appendix. The exacerbations of the pain are generally accompanied by constipation or evidences of intestinal fermentation, such as diarrhœa and flatus. The discomfort between the exacerbations is more or less continuous. Purgation in nearly all instances was followed by at least temporary relief.

With this evidence, it would seem fair to ascribe the symptoms exhibited by these patients to the relation of the appendix and its mesentery to the cæcum rather than to an inflammation of the appendix itself, even if the latter condition were found.

I am well aware of the danger of advancing a theory of this kind, since it might well be used for extending the field of meddlesome surgery. For this reason I have hesitated, and, although I have had the theory in mind for four or five years, I have abstained from bringing it forward until the repeated observation of this condition has forced me to believe that it is more than theory.

While most of the patients were women and neurasthenia might be a factor in the production of the symptoms, in the greater number it could be eliminated.

This relation may also explain the appendiceal pain observed in some cases of movable kidney in which appendectomy gives relief. In enteroptosis a short meso-appendix may readily cause tugging upon the appendix and cæcum. Finally, the constant tug on the appendix and cæcum is undoubtedly a cause of true appendicitis.

THE RADICAL TREATMENT OF CANCER OF THE RECTUM.[1]

WITH PARTICULAR REFERENCE TO THE VALUE OF INGUINAL COLOSTOMY.

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To the surgeon of to-day the study of carcinoma wherever found is one of peculiar interest and importance. With our present knowledge, the only treatment which offers relief from this disease is the operative, and with improved technique the field for operative interference is constantly widening, while the results are becoming more satisfactory. These facts, and the knowledge that cancer is becoming more and more frequent, are the incentives which tempt surgeons to attack the growth wherever and whenever it appears within reach of the knife.

Cancer of the breast, occurring as it does in an external part and in an organ which can be removed *in toto* without endangering life or causing a serious functional defect, affords the most promising results, and, except to bring all such cases to an earlier operation, it seems that no further advance can be made in the recognized treatment. Unfortunately, cancer of the rectum presents quite another set of conditions because of its hidden position and the anatomical and functional difficulties attending its complete eradication. However, the same principles are here in force, and it is to formulate the application of these principles that the records of the cases here presented have been collected and studied.

The cases at our disposal for this purpose are forty-six in number, all of which have been operated for the radical cure of cancer of the rectum, and in addition two cases of inguinal

[1] Read before the New York Surgical Society, March 22, 1905.

colostomy (one for cancer and one for syphilis of the rectum) in whom no rectal excision was done. Forty-four of the cases were operated on by various surgeons of New York City, seventeen in all, to whom I am indebted for the privilege of using their records,* and six, including the two colostomy patients, came under the care of the writer during the past year.

The study of the cases has been carried on mainly from the stand-point of determining results, and, if possible, of ascertaining the line of treatment which promises the largest per cent. of cures with the least sacrifice of functional control.

With this in view, the following two principles of the operative treatment of cancer have been kept in mind as essential to a cure. First, that cancer can be cured by operation only when it is attacked in an early stage. Second, that cancer can be cured by operation only when the growth itself is removed in its entirety, and with it all the immediately surrounding cancer-bearing tissue and the lymphatic glands draining these regions.

The study of the cases with reference to an early diagnosis is most instructive, and gives rise to hope for marked improvement in the matter of an earlier attack against the disease as it occurs in the rectum. The average period which elapsed from the appearance of symptoms which might have led to a diagnosis to the time when a diagnosis was actually made was about nine months, the shortest time being one week and the longest two years, this period occurring five times. The reasons for this tardiness in discovering the true condition are several. In the first place, the growth usually occurs sufficiently high in the bowel not to give any external manifestation, or, in its early stage, to interfere with sphincteric action.

Further, the early symptoms of rectal cancer are in no way characteristic and do not differ from those of many benign

* I desire here to express my thanks to Drs. Bolton, Briddon, Brown, Eliot, Johnson, Adrian Lambert, McCosh, McWilliams, Frank Markoe, Murray, Peck, Stimson, Tilton, Weir, and Woolsey. Also to Dr. Arthur R. Green, who collected the histories and followed the cases.

lesions of this organ. In nearly every case the first symptoms were pain and bleeding from the rectum. Nor do constitutional manifestations appear early enough to be of value in forming a diagnosis at the proper time. An appreciable cachexia was present in only one-third of the cases even at the time of operation. Finally, a sentiment of modesty oft-times deters the patient from fully reciting the symptoms present or from having the proper examination made. These all tend to delay, and not infrequently a patient is treated during a period of months for hæmorrhoids, fissure, or fistula, when a thorough examination would have revealed the true condition to be one of cancer. Several of the cases here reported gave such a history when finally they came under the care of the operating surgeon.

One case, No. 46 of the series, will illustrate this fact. A woman, aged twenty-six years, passed through a pregnancy, and was finally delivered at one of our hospitals. The delivery caused a laceration of the vagina and perineum through into the rectum for a distance of three inches. A month later she came under the care of the writer at the Lincoln Hospital to have this condition remedied. An examination showed the patient to be in an extremely cachectic condition and markedly septic. The perineal and rectal tears were foully infected, and a condition of complete incontinence existed, the region being filled with foul, purulent, fæcal matter. The parts were so excessively tender that no examination could be tolerated, and, after nearly a month's fruitless attempt to get them in a cleaner condition by antiseptic irrigations, an inguinal colostomy was done for this purpose. Examination showed that an encircling cancer of the rectum involving the vaginal wall was the true condition, and that this accounted for the pain and the sepsis. She had been under treatment nearly two years for some rectal trouble, and it must have been in existence when the child was born; yet it remained undiscovered.

Such cases emphasize the fact that the possibility of a rectal cancer must take a more prominent place in the minds of the profession at large, and that no fancied security against

the disease must be indulged in without a thorough examination. Mayo has formulated the principle that pyloric cancer to be successfully treated must be attacked before a positive diagnosis can be made in any less radical way than by an exploratory laparotomy. Accordingly, he advocates this procedure when one has good ground for *suspecting* the disease. This may be rather radical, but, severe as it is, the writer believes it would, if put into execution, lessen the suffering and mortality from cancer of the pylorus. An exhaustive examination of the rectum entails no such severity, and in the majority of cases can be performed in the office without an anæsthetic, and with no more inconvenience to the patient than is entailed in the giving of an enema.

It seems fair to say, therefore, that every patient who presents himself suffering from any symptom of lower bowel trouble is entitled to a thorough rectal examination, first digital, and, if this is negative, instrumental, with one of the proctoscopes now in general use. Only in this way can the diagnosis be made at a period when the hope of cure can be greatest. Youth is no guarantee against the disease, as five cases were less than thirty years old, the youngest being only twenty-three, and general statistics emphasize this point.

The accomplishment of the second principle in the bettering of results, namely, the complete eradication of the disease and the zone of danger surrounding it with their lymphatics, presents a far more difficult problem than the one just concluded.

The obstacles to this end are two. First, the anatomical and functional conditions of the rectum are such that the operative procedure itself is a dangerous one, and particularly liable to be followed by sepsis. Second, the destruction of the function of the rectum and anus to the degree needed for complete eradication of cancer is a matter of the utmost seriousness to the patient. The two obstacles are so closely related that the overcoming of one is apt to increase the other, and hence, in considering the best means to combat one, we must have constantly in mind the second.

In the present series of cases the operative mortality was 26 per cent., that is, 12 cases died as the direct result of the operation. An analysis of the causes of death shows that 7 cases, or 58½ per cent., died of sepsis in one form or another. Three cases died from the shock of the operation, and in two the cause was not given. Hupp, in the *Medical News*, September 28, 1901, with an analysis of 881 cases, quoting Krönlein, gives the mortality as 19.4 per cent. In the same article, with 171 cases analyzed for the cause of death, 83 just under one-half died from septic infection. Other observers put the proportion of death due to sepsis in some form at even a higher per cent., 60 to 70.

Severe as these percentages show the operation to be, we must acknowledge an even greater death-rate with our present technique, if an operative procedure is carried out which is radical enough to promise better permanent results, statistics now giving only 15 to 20 per cent. of cures. Our first consideration is to find a means then of lowering this mortality without sacrificing thoroughness. Earlier operation will do much in this direction, but a more important factor will be the elimination of sepsis. The cause of the infection is, of course, in the majority of cases, the contamination of the wound with fæcal matter either during the operation or immediately subsequent to it. This can in a great measure be avoided, and hence the mortality should be decreased by nearly, if not quite, one-half. The more radical operation needed to insure the best hope of a permanent cure would, on the other hand, increase to a certain extent the death-rate from shock and allied conditions, but this would be slight as compared to the gain from the elimination of fæcal infection.

How can this best be accomplished? The writer is strongly of the opinion that it can only be satisfactorily done by a complete deflection of the fæcal current from the normal channel, that is, by the formation of a complete inguinal colostomy. Much may be gained by a thorough attention to getting the bowels in good condition and the rectum cleansed from its purulent discharge by a week's or more treatment to this

end. Regulation of the diet so as to leave the least residue, mild catharsis so as to empty the bowels in spite of the constriction of the growth, and rectal irrigation twice daily with hydrogen peroxide, potassium permanganate or creolin followed by saline solution, are the means best suited to this purpose. At best, however, these only do away with a certain amount of the infection during the operation itself, while in badly constricted cases they accomplish nothing, and do not in any case provide against the subsequent infection from the passage of fæces over a fresh wound. It may be urged that in those cases where only a resection of a piece of the bowel is needed and an end-to-end anastomosis is done, the latter condition will not obtain because the anastomosis will be firm enough to prevent any leakage into the wound. Unfortunately, this is not true, because the union is not firm enough for this; and, moreover, this ideal method is applicable to only a very limited number of cases if a thorough eradication is obtained.

A frequent objection advanced against performing a preliminary inguinal colostomy is that this operation may interfere with the sufficient drawing down of the gut for the radical removal later to be performed. This objection carries no weight if the colostomy is done in such a way as to avoid it, which is a matter of easy accomplishment. In short, the preliminary colostomy accomplishes the end to be desired in a perfect manner, and is the only method that can accomplish it. Moreover, if indicated, the distal end of the artificial anus may be used for additional cleansing of the bowel during the time between its establishment and the rectal resection. Again, valuable information as to the extent of involvement of the rectum and pelvic organs may be obtained by exploration through the colostomy wound. Finally, this procedure is in most conditions followed by a marked general improvement of the patient during the convalescence, so that the three weeks which should intervene before the radical operation is done is a cause of gain more than enough to compensate for the loss of time in permitting an advance of the growth.

An equally important means of combating the development of sepsis is the exercising of the greatest care in avoiding contamination of the wound from the gut during the operation. The rectal caliber is never surgically clean, no matter what precaution and preparation are followed. This contamination can be accomplished by closing the bowel at the anus, and above and below any section of it by a purse-string suture, and then making the section with the actual cautery. It is difficult to say to just what extent this precaution is taken or neglected, but, judging from published articles and personal communications, it seems that its importance is not sufficiently appreciated.

The value of colostomy for the prevention of sepsis can be more definitely determined. In this series it was performed six times among those cases developing a serious sepsis, and nine times when no sepsis supervened. In nearly all of the fifteen cases, however, the colostomy was only a lateral anastomosis, and hence the requisite for protection of the wound, *i.e.*, complete deflection of the fæces, did not obtain. Severe infection occurred in only one of the five cases when the colostomy was complete. Marked fouling of the wound was present with subsequent infection, and a varying grade of sepsis in nearly every case where the colostomy was not used.

In one case of the series, No. 41, it was not performed as a preliminary, but had to be done during the radical operation, to avoid the certain later contamination of the wound with fæces because of inability to bring the gut flush with the sacral wound. In another, No. 45, where the ideal operation was performed, that is, resection of a segment with end-to-end anastomosis of the bowel, colostomy had to be done eight days later because the fæces caused breaking down of the union, and a sepsis supervened which could be controlled in no other way. Both these cases made good ultimate recoveries, and the latter was shown as an example of functional control in an inguinal colostomy. It therefore seems established that, without a complete colostomy, infection of the posterior wound and a sepsis often fatal is the rule, while with it

these conditions do not obtain. Unfortunately, the forming of a complete colostomy is not entirely devoid of danger, a number of fatal cases being found in the literature, and the writer having lost two in the past. These last, however, were due to errors in technique, as most of them have been, and the mortality ought to be found to be very low with improved methods.

There still remains to be considered the means by which a greater number of cures may be obtained in those surviving the operation with the best possible retention of fæcal control.

Of the 46 cases here reported, 44 were traced to their death or to the present time. A study of these shows a probable cure of about 16 per cent., counting freedom of return for three years as a cure. This conforms very closely to the statistics of all observers based on thousands of cases. The showing is not satisfactory, and we are justified in advocating new methods to improve it.

Our knowledge of cancer in general leaves only one means open for the obtaining of the best results as regards non-recurrence, namely, an operation which removes all cancer tissue, and with it all tissue which is liable to later cancer infection. The writer believes that this can be accomplished, except in the rarest instances, only by a removal of the rectum from well above the growth to and including the anal orifice, along with all lymphatic glands draining this area. In other words, the ideal operation, that is, preserving functional sphincters, is possible only in very rare cases.

The reasons for this belief are based upon the following facts:

First. In the majority of cases the growth is so situated that its lower border encroaches closely on the sphincters; hence it cannot be removed completely and leave behind a sufficient distal segment to which to attach the proximal end with the hope of a sphincteric control. In every case here reported the growth was easily within the reach of the finger, and the great majority were recorded as about two inches from the anus.

In other words, they were so situated that saving the anal segment was entirely out of the question, and it was unhesitatingly sacrificed. Statistics from various sources show that in more than half the cases a safe zone distal to the growth does not exist.

Second. Gerota has shown that the lymphatics draining the rectum are divided into four groups: 1. The anal skin; 2. The intermediate anal; 3. The columnar anal; 4. The group draining the rectum proper. Of these, group 1, that is the anal skin, drains both outward towards the thigh and inguinal glands and upward into group 3. The other three groups all drain upward, following in general the course of the superior hæmorrhoidal artery branches. The glands and vessels which are placed at first laterally thus become more and more posterior until they finally all drain into the glands occupying the sacral hollow nearly as high as the promontory between the converging leaves of the peritoneum, which is here forming the mesosigmoidea. It will be noted that even the anal margin has an anastomotic circulation of lymphatic vessels with this superiorly situated group, and so in cancer low down the sacral glands are a source of recurrence and should be removed.

This extensive distribution of lymphatics (Funke found that two-thirds of operative cases showed glandular involvement) necessitates a correspondingly extensive operation, and the intimate association of the various groups makes it imperative to remove them all, except the inguinal glands when these show no involvement. This can be accomplished satisfactorily only when no attempt to save the sphincters is made, and an amputation is done.

Third. The desire to save the lower segment, and thus keep the sphincter intact, often tempts the surgeon to leave more of the gut than his better judgment dictates, just as the desire to avoid the scar of engrafted skin may lead to a too close section in the case of mammary cancer. A frank abandonment of this hope except in rare cases will avoid falling into this error.

Fourth. It is commonly accepted that a constantly re-

curring irritation of a part which is liable to cancer development is an etiological factor in producing the neoplasm. An end-to-end anastomosis must inevitably produce some scar tissue with a certain amount of constriction as its sequela, and this in the tissue of an individual who has a cancer tendency and in a part which is subject to constantly recurring irritation. Statistics show that in most cases the recurrence takes place locally. In this series the per cent. is 100, every case that showed a return having the growth in or about the rectum.

It would therefore seem that the attempt to retain the anal portion even in high situated cancers is open to many objections, and that the results, so far as obtaining a cure is concerned, would be improved by sacrificing it. This opinion will probably be accepted without debate; but the question immediately arises as to whether the functional mutilation thus entailed justifies the end. In answering this, the first point to be considered is a comparison of this functional mutilation with that resulting from a less radical operation.

It has already been pointed out that considerably more than 50 per cent. of all rectal cancers are so situated that a saving of the sphincters is out of the question. In the remaining cases these muscles might possibly be saved as anatomical structures, but this does not mean functional integrity. The high situated cancers in which the sphincters are in the safe zone require a correspondingly high resection and complete removal of sacral glands and interstitial tissues. This means an extensive deep dissection which will surely to a greater or less extent damage the innervation of these muscles, and to this same extent impair fæcal continence. It is difficult to measure the degree of functional control present under such circumstances, but it is certain that often there is little. In this series not more than one or two cases so operated got a really good control of the bowels. Hence the chief objection (namely, the impairment of function) to the extirpation of the rectum from well above the growth to the skin becomes invalid, because this impairment is no greater than with a

less radical procedure, and the method has the great advantage of promising the surest immunity from recurrence.

The final problem to be solved is what substitute shall be made for the sphincters thus destroyed. Two accepted procedures are in use,—one, the sacral or perineal method, and the other, the inguinal method. The latter when properly performed seems to the writer to hold out the promise of giving the greatest functional control, and to this is added the advantage, already shown, of having the anus so situated, as a preliminary to the radical operation, in reducing the mortality of the latter.

A great advance has been made in recent years in so forming the colostomy that some satisfactory substitute for a sphincter shall result, and there are many cases on record in which patients with this condition have lived in comfort without interfering with their usual occupations.

It is not necessary to enter into a complete discussion of the various methods advocated. Suffice it to say that some form of intermuscular operation seems to offer the most favorable results.

Earlier diagnosis and a complete eradication of the growth, done after the following method, promises, then, the most satisfactory results both as regards permanency of cure and functional integrity.

An inguinal colostomy is first performed by drawing the sigmoid through an intermuscular incision just external to the left rectus muscle and dividing it between two ligatures. The point of division should be as low in the bowel as possible, thus leaving a large sigmoid pouch as a reservoir above the new anus. The distal end is closed and dropped into the pelvic cavity, or, if indicated, may be fastened in the lower angle of the wound for the purpose of through-and-through irrigation. In this case the lower segment must be left sufficiently long not to interfere with the radical excision to be done later.

An incision is then made in the linea alba at the same level as the intermuscular incision, or, better, slightly above it,

and the anterior sheath of the rectus between the two incisions raised up from the muscle. The proximal end of the gut with its mesentery is then drawn under this strong sheath over the rectus muscle, and fastened into the skin and fascia wound in the middle line. This opening must not be too small, because it shows a tendency to contract and form a stricture. The gut is tacked to the peritoneum where it emerges from the peritoneal cavity, and the skin and fascia wound is here closed. A protective dressing can be so applied as to insure almost complete primary union. It is well to insert a small catheter into the proximal gut for a distance of six or eight inches to facilitate the passage of gas during the first days following operation.

Three weeks later the radical amputation is done. The patient is put in the exaggerated knee-chest position, which controls to a remarkable degree the venous oozing, and an incision made from the third sacral vertebra downward to and around the anus. The anus is then tied with a purse-string suture, and the eradication of the growth and all the glands begun. The coccyx and one or two sacral vertebræ are resected, and the presacral tissues as high up as the second vertebra are pushed away from the bone, saving only the sacral nerves. This includes all the lymphatic glands and vessels which are apt to be infected.

Ligation of the superior hæmorrhoidal artery is next done, and then the gut is free posteriorly. It is now freed laterally and the peritoneum opened when reached. This permits the drawing down of the rectum even up to the blind end, or, if the end was fastened in the colostomy wound, well up towards that point. In the former case the whole lower segment will be removed; in the latter the gut is divided between two purse-string sutures with the actual cautery and the upper end closed. This technique obviates the leaving of a piece of bowel closed at both ends, a procedure which has been shown to be dangerous.

Beginning at the upper division, the gut to be removed is separated from its anterior and remaining lateral attachment

from above downward, and finally removed in one piece with all lymphatics and glands attached to it. The peritoneum is sutured, the closed end of gut, if present, being fastened in the opening, the wound closed, and a small drain put in it.

This method can be carried out with no fæcal contamination to the wound, and, as Tuttle has pointed out, the starting above and working downward has the advantage of avoiding cutting through the infected lymphatic tissues. This advantage is analogous to the one of beginning the removal of breast cancer at the most distal lymphatic glands and working towards the growth in the mammary gland.

The detailed histories of the cases follow and the percentage statistics are tabulated.

CASE 1.—I. S., aged thirty-four years; female; white. New York Hospital, Dr. Bolton. Adenocarcinoma.

Family History.—Negative for neoplasm.

History.—Began four months previous to operation with painful defecation and blood in stools. Experienced sharp pain in lower part of rectum. Marked loss of strength and fifteen pounds weight during past six months.

Physical Examination.—Rather anæmic, well-nourished woman. Local. Nearly impassable stricture of rectum three and one-half inches from anal opening, due to a mass palpable through vagina.

Operation.—February 9, 1904. Preliminary colostomy. Kraske-Sims position. Rectal irrigation; coccyx and small piece of sacrum removed; four inches of gut excised; end-to-end suture of gut. Hæmorrhage slight.

Postoperative.—Large amount of fæcal discharge, February 12 to March 11. February 18, wound partly broken down.

Discharged May 14. Gained twenty pounds. Inguinal colostomy wound still open.

Present condition. February 16, 1905, has "pretty good" control over defecation (by way of artificial anus). Anal fistula does not close. Considerable gain in weight.

CASE 2.—M. K., aged forty-six years; female; white; housewife. Presbyterian Hospital, Dr. McCosh. Malignant adenoma.

Family History.—Negative for neoplasm.

History.—Nine months previous to operation patient noticed her stools were streaked with blood, which condition prevailed at intervals. Diarrhœa followed and became progressively more marked,—ten to twelve movements daily. Size of fæces gradually became smaller. Considerable rectal tenesmus. Loss of strength. Weight normal.

Operation, January 20, 1898.—Perineal incision. Coccyx removed. Distal ten inches of gut excised and proximal end sutured to a remaining one and one-half inches of gut at anus. Operation followed by rectal obstruction. Dilatation. Discharged improved, June 5, 1898. Died later.

Case 3.—F. L., aged twenty-eight years; male; white. Presbyterian Hospital, Dr. Brown. Adenocarcinoma. (July 25, 1899.)

Family History.—Negative for neoplasm.

History.—Began four years previous to operation with pain in rectum and blood in the stools. Was operated on at that time for tumor of rectum. Passages were free. Since that time has been well until three months previous to present operation, when the pain returned. Pain is not severe, but annoying and remains after defecation. Movements are formed.

Operation (second).—July 25, 1899. Incision in median line of sacrum in old scar. Dense connective tissue found surrounding the rectum, divided, gut dissected out, drawn down, mass excised, end-to-end suture of gut.

Discharged cured, August 27, 1899. Died shortly after leaving the hospital.

Case 4.—J. M., aged fifty-six; male; white; tailor. Presbyterian Hospital, Dr. McCosh. Carcinoma.

Family History.—Negative.

History.—Nine months previous to operation noticed blood in stools, which continued; fæces progressively grew smaller, to size of lead-pencil. Moderate pain. Six to eight stools daily.

Physical Examination.—Local. Hard, ragged mass on anterior rectal wall, one and one-half inches from sphincter.

Operation.—January 10, 1898. Perineal. Schleich No. 2 anæsthesia. Coccyx removed. Gland in left side of pelvis enlarged; removed. Hæmorrhage considerable; controlled by

sponges. Distal end of gut excised; perineal end sutured to skin. Silk sutures. Died, January 13, 1898.

CASE 5.—M. W., aged twenty-three years; male; white. New York Hospital, Dr. Hartley. Gelatinous carcinoma.

Family History.—Negative for neoplasm.

History.—Bowels always regular and rather loose. Ten years ago was kicked in perineum, and thinks he noticed traces of blood in stools since then. One month previous to operation had tenesmus and constant desire to go to stool, but rarely passed any fæces except after taking cathartic. Stools became pencil shaped, streaked with mucus and blood.

Physical Examination.—Tight ring one and one-half inches above anus; apparently similar ring one-half inch higher; considerable bleeding on examination.

Operations.—June 26, 1900. Stricture divided, July 20, 1900. Kraske, November 24, 1900. Incision in line of old scar. Cartilaginous constriction extending about gut, divided for two and one-half inches. Colostomy.

Discharged improved, January 10, 1901. Died about one year later.

CASE 6.—P. W., aged forty-two years; male; white; laborer. Bellevue Hospital, Dr. Tilton. Carcinoma recti.

Family History.—Negative for neoplasm.

History.—Enjoyed good health until five years previous to operation. One month previous to operation was so constipated that medicines of all kinds were taken without result.

Physical Examination.—Well nourished. Presence of hard nodular growth obstructing lumen of rectum.

Operation.—April 29, 1904. Exaggerated lithotomy position, hips raised. Incision, second sacral spine to one-half inch posterior to anus. Coccyx and sacrum to fourth foramen removed. Mass excised. Small sacral glands also. Proximal end of gut sutured to anal mucosa. Time, one and one-half hours.

Postoperative.—Bladder washings for cystitis.

Discharged, June 18, 1904.

March 15, 1905, still living and in good health. Has some control over bowels, but cannot keep clean through tendency to stricture contraction at anal orifice. This required cutting on March 7.

CASE 7.—J. M., aged sixty years; male; white; laborer.

Bellevue Hospital, Dr. Hartwell. Pathological report: Carcinoma. Inguinal glands not malignant.

Family History.—Negative for neoplasm.

History.—Six months previous to operation patient experienced pain at defecation, knife-like in character; later, this changed to a burning sensation lasting some hours after defecation. Four months previous to operation, noticed blood in the stools.

Physical Examination.—Cachectic. Hard, somewhat friable growth one and one-half inches above anus. Lumen of the gut obliterated. Inguinal glands involved.

Operations.—July 9, 1904. Inguinal colostomy by method of using anterior sheath of rectus and the rectus muscle in constructing sphincter. August 5, 1904. Knee-chest position. Kraske incision second sacral spine to one inch above anus, encircling it. Coccyx and two lower sacral vertebræ removed. Hæmorrhage, not severe, controlled by clamp and ligature. Mass excised between ligatures. Six inches of gut and anus removed. Proximal end closed. Sacral glands and areolar tissue removed. Wound closed with drainage.

Postoperative.—August 30. Primary union.

Discharged in six weeks.

March 22, 1905, has excellent control over inguinal anus, and his general condition is very satisfactory. No recurrence.

Case 8.—F. S., aged sixty years; female; white; housewife. Presbyterian Hospital, Dr. Eliot. Malignant adenoma.

Family History.—Negative for neoplasm.

History.—Began two years previous to operation with painful defecation and straining at stool. (Constipated.) Pain continued two to three hours after action. Stools became small in size and coated with blood. Dull ache in sacrum and thighs. Eight months previous to operation stools still painful but not more frequent, size of lead-pencil. Loss of flesh.

Physical Examination.—Poorly nourished, anæmic, cachectic. Internal hæmorrhoids. At internal sphincter series of masses surrounding gut.

Operation.—December 12, 1900. Sims's position. Kraske operation. Glands not noted. Hæmorrhage controlled by sponge.

Postoperative.—Mental condition cloudy. Wound sloughing. December 19. Considerable fæcal discharge. December 24.

Movements through posterior wound, not through anus. Movements involuntary. January 4. Bedsore of right trochanter. Sloughing. January 6. Died.

CASE 9.—A. M. R., Brooklyn; aged forty-nine years; female; white. New York Hospital, Dr. Murray. Carcinoma.

Family History.—Negative for neoplasm.

History.—Habitual constipation, which grew worse with time. One month previous to operation was unable to introduce smallest size nozzle to secure enema. Slight pain one week previous to operation. Loss of strength, not of flesh. No hæmorrhage.

Physical Examination.—General condition good. Local. Nodular mass completely surrounding gut in region of sphincter.

Operation.—May 21, 1903. Lithotomy position. Perineal incision encircling the anus. Mass excised. Surrounding tissues involved (possibly some growth left). End of gut sutured to skin wound.

Postoperative.—Healing by granulation. Complete control of sphincter.

Discharged cured (improved), June 22, 1903. Died, January, 1905, after going to hospital for second operation.

CASE 10.—C. M., aged twenty-seven years; female; white; seamstress. Bellevue Hospital, Dr. Hartwell. Carcinoma.

Family History.—Negative.

History.—Pain and blood in stools for a few weeks only.

Physical Examination.—Some cachexia. Friable mass reaching around bowel two inches above anus.

Operation.—August 19, 1904. Simple complete colostomy.

Postoperative.—Complained of weakness daily.

Operation.—August 26, 1904. Preliminary irrigations through colostomy wound, August 29. Modified Kraske. Knee-chest position. Incision from second sacral spine to one-half inch posterior to anus. Lower part of sacrum (third foramen) and coccyx removed. External sphincter left. Four inches of gut excised, free end sutured to anal portion. Anæsthesia, three and one-quarter hours.

Postoperative.—Hot saline infusion. Catheterization. September 2. Irrational. September 4. Delirious; vomited greenish fluid. September 4. Coma. Died. Cause of death, shock and some sepsis, though no sloughing.

CASE 11.—A. W., aged fifty-eight years; female; white; housewife. Presbyterian Hospital, Dr. Briddon. Malignant adenoma, Dr. Thacher.

Family History.—Negative.

History.—Twelve years previous to operation patient had hæmorrhoids, which lasted for a few months and then disappeared. Nine months previous to operation pain was experienced in rectum, posteriorly, during defecation. Blood was occasionally noticed and caliber of stools became smaller. Loss of weight and appetite.

Physical Examination.—Neoplasm size of chicken's egg, just above internal sphincter.

Operation.—January 6, 1899. Prone position. Perineal and sacral incision with division of sacrum at third vertebra. Enlarged glands in adipose tissue. Rectum divided between clamps and growth excised. End-to-end suture of gut. Hæmorrhage controlled by clamp and ligature.

Postoperative.—Considerable amount of foul discharge from wound. Abdominal distention. Involuntary defecation and urination. Septic. Died January 10, 1899.

CASE 12.—F. N., aged fifty-eight years; male; white. New York Hospital, Dr. Weir. Carcinoma.

Family History.—Negative for neoplasm.

History.—Began one year previous to operation with constipation, straining at stool, frequent passage of blood in stools. Two doctors diagnosed bleeding piles and gave medicine. No examination made. Patient became worse. Frequent desire to defecate resulting in no movement. Intense pain in back, groin, testicle, and penis. One month previous to operation diagnosis of carcinoma was made and patient sent to hospital.

Physical Examination.—Large mass two inches above anus extending entirely around gut.

Operation.—November 22, 1898. Colotomy. December 7, 1898. Incision of anus to third sacral foramen. Sacrum and coccyx excised. Six inches of gut excised, end-to-end suture of sigmoid to remaining two and one-half inches at anal extremity. Glands of rectum involved. Signs of shock during last twenty-five minutes of operation.

Postoperative.—Considerable fæcal discharge. Wound infected. December 10, 1898. Cheyne-Stokes breathing. December 11. Died.

CASE 13.—F. C. N., aged fifty-two years; male; white. New York Hospital, Dr. Weir. Carcinoma.

Family History.—Negative for neoplasm.

History.—Noticed blood in stools, June, 1898. Some pain. Condition lasted seven days. January 1, 1899. Had sudden onset of cramps in left calf and thigh and pain in back and rectum. Constant feeling of distention and desire to defecate. Marked constipation. Much straining. Urination frequent.

Physical Examination.—Hard nodular bleeding mass encircling rectum as high as finger can reach and as low down as one inch from anus.

Operation.—February 25, 1899. Colostomy. March 11, 1899. Sims's position. Incision of anus to coccyx. V piece of sacrum and coccyx removed. Mass excised between ligatures of gauze. Suspicious adnexa removed. Hæmorrhage free, controlled with great difficulty. Patient in collapse. Died, March 12, 1899, from shock.

CASE 14.—I. J. M., aged thirty-seven years; female; white; actress. New York Hospital, Drs. Markoe and Hartley. Adenocarcinoma.

Family History.—Negative for neoplasm.

History.—Pelvic peritonitis nine years previous to operation. Five years previous to operation suffered from abdominal pain. Operation, tube and ovary removed, Homœopathic Hospital, Buffalo. Similar attack, January, 1901. Operation, St. Mark's Hospital, New York City. Abdominal incision, drainage through vagina. Vaginal sinus persisted. June, 1901. Temperature and abdominal pain; went to Homœopathic Hospital, Buffalo; treatment, antiphlogistine poultices to abdomen; result, sinus opened, which has persisted. Discharge fæcal at times from abdominal sinus.

Physical Examination.—Well nourished, moderately anæmic. Grayish facies (cachexia?). Posterior fornix occupied by indurated mass.

Operation.—December 11, 1901. Dr. Markoe. Abdominal incision. Mass behind uterus dissected out. January 22, 1902. Dr. Hartley. Abdominal fluid and gelatinous material evacuated.

Complication. Bronchopneumonia. Died April 21, 1902.

CASE 15.—T. H. B., aged thirty-three years; male; white. New York Hospital, Dr. Hartley. Carcinoma.

Family History.—Negative for neoplasm.

History.—Began four months previous to operation with pain in region of rectum; was treated for hæmorrhoids. Pain at times sharp and shooting. Constipation. No notice of decrease of weight.

Physical Examination.—General condition good. Local: Mass four inches from anus attached around lumen of gut. Not adherent to bladder.

Operation.—June 29, 1901. Sims's position. Incision from median line of sacrum to anus; coccyx removed. Mass excised, end-to-end suture of gut. Sterile gauze.

Postoperative.—Pulse weak and rapid. Skin cold (shock?). Died June 30, 1901.

CASE 16.—M. R., aged fifty-three years; female; white. New York Hospital, Dr. Johnson. Carcinoma.

Family History.—Negative for neoplasm.

History.—Was always well and strong until eight months previous to operation. At that time experienced an uncomfortable sensation about the anus and in pelvic region. For two months previous to operation was very constipated, movements impossible, pain severe. Hæmorrhages from rectum just previous to operation, also a bloody discharge from the vagina. Loss of flesh and strength.

Physical Examination.—General condition good. Vaginal: Near outlet of floor of vagina a hard, ulcerating mass, vagina freely movable over it. Rectal: So indurated and occluded that finger cannot pass.

Operation.—July 23, 1903. Perineal incision—right of centre—from vagina to anus, encircling it. Tumor extended up rectum for two and one-half inches. Rectum pulled down, tumor excised, and gut sutured to skin wound. Posterior wall of vagina sutured to free edge of skin at anterior portion of perineal wound.

Postoperative.—July 26. Chills. Temperature, 106.6° F.; pulse, 140; respirations, 32. Involuntary defecation. August 1 to 5. Delirious. Complication, nephritis. Died August 8, 1903, probably from sepsis.

CASE 17.—W. F., aged fifty-two years; male; white. Presbyterian Hospital, Dr. Woolsey. Epithelioma.

Family History.—Negative for neoplasm.

History.—(Syphilis and rheumatism.) For three to four

years previous to operation had lumps about the anus, which were painful and disappeared on treatment. For past year lumps have been permanent, are painful, bleed on defecation. For eight months previous to operation had a discharge of yellow fluid continuously.

Physical Examination.—Poorly nourished, anæmic. Inguinal glands somewhat enlarged, prostate not enlarged. Mass on right side of rectum size of chestnut, surface uneven. No enlarged glands in pelvis.

Operation.—July 15, 1900. Lithotomy position. (Hæmorrhoids excised.) A circular incision was made about the anus. Mass pulled down and excised. Skin sutured to mucous membrane over the area. Gauze drain. Time, thirty minutes.

Discharged cured, July 25, 1900. Alive and well, March 1, 1905. Has satisfactory control over bowel. No return of symptoms.

CASE 18.—J. S., aged forty-nine years; male; white; laborer. Presbyterian Hospital, Dr. Briddon. Adenocarcinoma.

Family History.—Negative for neoplasm.

History.—Eight months previous to operation patient noticed blood in stools, but had no pain. Two months later he experienced a dull, heavy pain in rectum, more marked at night. Bowels constipated. No diminution in caliber of stools. No cachexia. Some loss of flesh, more loss of strength.

Physical Examination.—No cachexia. Hard ulcerated tumor, size of almond, felt on left rectal wall, one inch from anus, involving sphincter. Prostate enlarged.

Operation.—October 18, 1899. Lithotomy position. Perineal incision, distal three inches of gut excised, proximal end sutured to skin incision. Sphincter muscles cut in removing the growth. Hæmorrhage severe, controlled by clamp and ligation.

Postoperative.—October 20. Suprapubic cystotomy. November 6. Catheter inserted for continuous drainage of bladder. Delirium lasting over one month.

Discharged January 31, 1900. Died February, never having regained any control over sphincter ani.

CASE 19.—A. M., aged fifty-three years; female; white; housewife. Presbyterian Hospital, Dr. Brown. Malignant adenoma (colloid).

Family History.—Negative for neoplasm.

History.—Began six months prior to operation with diarrhœa and occasional passage of blood and pus in stools. For two months previous to operation desire to defecate has been almost constant. Movements are painful and difficult. Fæces passed in small round balls. Difficult to start stream in urination.

Physical Examination.—Patient fairly well nourished. No enlargement of superficial glands. Local: Nodular mass extending two-thirds around rectum on left side.

Operation.—September 4, 1900. Prone position. Hips raised. Median incision sacrum to anus. Sacrum and coccyx excised, rectum excised, artificial anus below site of excised sacrum. No infiltration of surrounding tissue. Time, two hours.

Postoperative.—Free purulent discharge from wound for over a month. Pain in wound. No control over bowel.

Discharged cured, November 1, 1900. Died January 9, 1902, never having regained any control over bowels.

Case 20.—J. M. M., aged forty-seven years; male; white; electrician. Presbyterian Hospital, Dr. Eliot. Adenocarcinoma.

Family History.—Negative for neoplasm.

History.—Nine months previous to operation had severe fall, striking coccyx on stone steps. Six months previous to operation patient noticed obstruction in rectum and traces of blood in stools. Later movements became ribbon shape, and after movements experienced a dull aching pain. Three weeks previous to operation stream of urine became gradually smaller and urination more frequent.

Physical Examination.—Weight has increased, no enlarged glands. Well nourished. Local: Had immovable fungating mass just within anal margin, size of plum; three inches higher up a firm annular stricture.

Operation.—October 17, 1900. Prone position. Sacral flaps (Kraske). Growth adherent to bladder. Rectum divided four inches from anus. Free end sutured to upper outer angle of wound.

Postoperative.—Discharge from wound abundant. Urinary fistula. Incontinence of urine and fæces.

Discharged cured, December 22, 1900. Readmitted to hospital, March 9, 1901. Rectovesical fistula. Incontinence of urine and fæces. Physical examination: Well nourished, not anæmic,

no glands. Discharged improved, March 16, 1901. Died October, 1901, never having any control over defecation.

CASE 21.—J. C. G., aged fifty-nine years; male; white. New York Hospital, Dr. Hartley. Adenocarcinoma.

Family History.—Negative for neoplasm.

History.—Nine years previous to operation injured spine in railroad accident. Two years previous to operation had itching and bleeding piles. Constipation marked. Loss of flesh and strength. Few months previous to operation passed blood and pus in stools. Stools became smaller in caliber. Urination difficult.

Operation.—June 2, 1898. Lithotomy position. Perineal incision from coccyx to anus. Coccyx removed. Hæmorrhage considerable. Growth adherent to tissues. Mass excised, free end sutured to skin wound. Artificial anus.

Postoperative.—Semiconscious, delirium, pain in abdomen. Died June 12, 1898.

CASE 22.—G. C. M., aged sixty-three years; male; white; driver. Presbyterian Hospital, Dr. McCosh. Carcinoma.

Family History.—Negative for neoplasm.

History.—About ten months previous to operation patient began to suffer from an indefinite pain in the abdomen, followed by frequent and painful defecation; eight to ten movements in twenty-four hours; rectal tenesmus marked. Loss of sphincteric control with involuntary defecation and urination.

Physical Examination.—Local: Carcinomatous mass three inches from anus; apparently no glandular involvement.

Operation.—December 13, 1898. Preparatory treatment, diet and stimulation. Combined operation with sacral flap and division of sacrum at fourth interspace. Upper end of rectum involved in carcinomatous mass. Mass excised. Lower end of sigmoid sutured to upper border of skin wound. Lower end of gut clamped. Iodoform gauze drain. Hæmorrhage considerable, controlled by clamps.

Postoperative.—Considerable discharge from posterior wound; dark green and foul smelling. Patient died, December 15, 1898, with wound in septic condition.

CASE 23.—M. E. C., aged forty-four years; female; white. New York Hospital, Dr. Hartley. Adenocarcinoma.

Family History.—Negative for neoplasm.

History.—Colotomy, June, 1897, after suffering from condition one year. (Thought to be inoperable at time of colotomy.)

Physical Examination.—Cauliflower mass two inches beyond anus encircling entire gut.

Operation.—November 15, 1898. Semiprone position. Median incision sacrum to anus. Sacral flap. Surrounding tissues infiltrated. Mass excised, end-to-end suture of gut. Time, one hour, thirty-five minutes.

Postoperative.—Considerable discharge from wound.

Discharged improved, January 1, 1899. "Was well enough after operation to attend reception. Had constant pain, but bowels were under comparative control. Dropsy, January 5, 1900." Died January 5, 1900.

CASE 24.—C. H., aged thirty-five years; female; white; housewife. Presbyterian Hospital, Dr. McCosh. Adenocarcinoma.

Family History.—Negative for neoplasm.

History.—Nine months previous to operation passed blood at stool. Five weeks later, while at stool, had a piercing pain in rectum; painful and bloody defecation since; caliber of fæces not diminished.

Physical Examination.—Health has been as good as usual. Corpulent, anæmic. Area of ulceration size of silver dollar two inches above external sphincter. No stricture.

Operation.—April 2, 1898. Lithotomy position. Perineal incision. Coccyx resected. Distal six and three-quarters inches of gut excised. Proximal end sutured to anal site. Glands in surrounding tissues involved. Hæmorrhage considerable, controlled by clamp and sponge. Gauze drain. Foul purulent rectal discharge for days following operation. Pain in abdomen and about anus. Painful defecation and urination.

Discharged May 5, 1898. Died July 22, 1899. The control over bowels was never regained.

CASE 25.—L. M. W., aged thirty-four years; male; negro; dyer. Presbyterian Hospital, Dr. McCosh. Malignant adenoma.

Family History.—Negative.

History.—One year previous to operation noticed blood and mucus at stool. Pain and tenesmus followed one month after initial symptoms, with constant desire to defecate. Loss of weight and strength.

Physical Examination.—Poorly nourished, weak. Epitheliomatous growth, with cauliflower formation involving lower four inches of rectum, adherent to bladder and prostate. Inguinal colotomy, October 8, 1896.

Operation.—November 5, 1896. Perineal incision. Part of prostate and enlarged glands removed, ten inches of rectum excised. Artificial anus: rectum stitched to posterior skin incision. Very vascular, controlled by sterile dressing. November 28. Dejecta from artificial anus.

December 10. Discharged cured. Doing well. Died April 25, 1897. The functional control was never good.

CASE 26.—J. R., aged thirty-five years; male; white; butler. New York Hospital, Dr. Murray. Colloid carcinoma.

Family History.—Negative for neoplasm.

History.—Operation for tumor of rectum, St. Luke's Hospital, February, 1897. Was well until April, 1898, when he reverted to condition previous to operation. Marked flatulence, great constipation, digestion poor, pain on defecation, stool hard, scybalous, streaked with blood and mucus. Had medical attention with diagnosis. "Catarrhal proctitis." Loss of strength and twenty-five pounds weight.

Physical Examination of Rectum.—Posterior and to left indurated, flat, rough growth, reached by finger.

Operation.—September 10, 1898. Sacrum diseased, operation discontinued. September 17, 1898. Lithotomy position. Incision anus to coccyx. Four inches of gut excised. Artificial anus at upper angle of wound. Anus sewed up.

Postoperative.—November 4. Posterior sinus healed.

Discharged improved, November 8, 1898. Temporarily improved; condition recurred. Died, 1899.

CASE 27.—J. M., aged forty-five years; female; white; milliner. Bellevue Hospital, Dr. Tilton. Carcinoma.

Family History.—Negative for neoplasm.

History.—Began eight years previous to operation with pruritus and pain about anus. Unable to sleep at night. Ten days previous to operation had bloody discharge. Excessive pain on and after defecation. Constant stinging pain. Micturition painful.

Physical Examination.—General: A little emaciated and haggard.

Operation.—September 29, 1904. Sphincter ani dilated. "Lower two inches of rectum together with hard tumor removed. Hæmorrhage stopped. Skin and mucous membrane fastened together by black silk."

Postoperative.—October 3. Considerable discharge from wound. October 22. Slight discharge from wound.

Discharged December 11, 1904. Has fair control over bowel. Has recently experienced shooting pain in rectum.

CASE 28.—M. R., Brooklyn; aged forty-seven years; female; white. New York Hospital, Dr. Hartley. Adenocarcinoma.

Family History.—Negative for neoplasm.

History.—Began two years prior to operation with pain on defecation and bloody discharge from the rectum. Pain lately increased in severity, becoming constant in coccyx and thighs.

Physical Examination.—Fairly well nourished. Local: Ring of papillomatous growths constricting the lumen three inches above the anus.

Operation.—January 6, 1903. Modified Kraske. End-to-end suture of gut.

Postoperative.—Discharge of fluid and mucus. Complication, colitis.

Discharged cured, February 22, 1903. Recurrence about July, 1904, and admitted to Presbyterian Hospital, in Dr. Woolsey's service.

Physical Examination.—General: Poorly nourished. Rather pale, slightly cachectic. Tubercular involvement of left upper lobe and slight of right upper lobe of lungs. Local: Nodular growth of lower end of rectum, above which is a cicatricial stricture of previous operation. Rather lax sphincter.

Operation.—August 31, 1904. Position, left lateral. Coccyx exposed and removed. Tumor removed. Perforation in the rectum closed with catgut. Drain inserted. Good condition.

Postoperative Condition.—Wound over the sacral region healed clean. Pain completely relieved. Sphincteric action weak but improving.

Discharged September 18, 1904.

March 15, 1905. Still living and in very fair condition. Has very good sphincteric control.

CASE 29.—W. P., aged twenty-seven years; male; white; boiler-maker. Presbyterian Hospital, Dr. McCosh. Adenocarcinoma.

Family History.—Negative.

History.—Bleeding from rectum and pain on defecation for two years. No history of cachexia.

Physical Examination.—Ulcerated mass felt on the wall of rectum low down. Glandular involvement not mentioned.

Operation.—June 6, 1895. Lithotomy position. Gut pulled down, stitched to skin, and end excised (four inches). Gauze drain inserted. Hæmorrhage easily controlled by sponges. Condition of patient good.

Complications and Sequelæ.—Considerable pain, relieved by morphine. Pain on micturition. Wound discharged pus, mucus, and blood. Urinary fistula into rectum.

Discharged cured, June 28. Function good. Recurrence within two months. Second operation, August 20, 1896. Discharged cured, September 7, 1896.

March, 1905.—Patient at work. Has gained forty pounds in weight. Control fair. Longest period of cure recorded in this series.

CASE 30.—M. J., aged thirty-nine years; female; white; laundress. New York Hospital, Dr. Markoe. Adenocarcinoma.

Family History.—Negative for neoplasm.

History.—Began eight months previous to operation with blood in stools. Condition became worse from month to month. Three months previous to operation had difficulty in moving her bowels. For two months previous some pain, not severe. Alternate attacks of constipation and diarrhœa. Had three attacks of obstruction, vomiting, pain. Relieved when bowels moved.

Physical Examination.—Well nourished, obese. Local: Mass on anterior rectal wall (ulcerating) one and one-half inches in diameter.

Operation.—January 20, 1903. Prone position. Sacral flap. Mass excised, one inch from growth, three-quarters from anus. End-to-end suture of gut. Hæmorrhage moderate, shock marked.

Discharged cured, March 5, 1903. Not heard from since.

CASE 31.—B. R., aged fifty-six years; female; white. New York Hospital, Dr. Stimson, Dr. Johnson. Adenocarcinoma.

Family History.—Negative for neoplasm.

History.—Began two years previous to operation with difficulty at stool. Fæces passed in small particles, accompanied by blood and bearing-down sensation. Dull ache in rectum before defecation. Frequency of defecation; improved under treatment. Loss of strength and twenty pounds weight.

Physical Examination.—Moderately well nourished, skin and mucous membrane of good color. Local: Indurated, raspberry-like mass encircling gut two inches from anus; no ulceration; no glandular involvement.

Operation.—October 31, 1903. Prone position. Median incision. Excision of coccyx, sacrum, and gut containing tumor; end-to-end suture of gut.

Discharged cured, December 28, 1903.—"Granulations have tendency to be sluggish." Recurrence; returned to hospital.

Physical Examination.—General condition good. Robust, complexion ruddy. Local: Large mass encircling rectum one and one-half inches deep.

Operation.—May 23, 1904. Dr. Johnson. Mass excised. Rectum sutured to sacral end of skin wound.

Discharged, improved, June 13, 1904.

Has been in bed over four months, cannot sit up because wound pains her so. Wound does not heal. Has no control over bowel. No return noticeable. Has suffered since operation with la grippe, dysentery, and dyspepsia.

Case 32.—A. B., Brooklyn; aged forty-nine years; female; white; seamstress. New York Hospital, Dr. Bolton. Carcinoma.

Family History.—Negative for neoplasm.

History.—Habitual constipation. Four months previous to operation, experienced painful defecation. Constipation severe; soon after blood in stools; stools small. Lost twenty pounds. Indigestion marked.

Physical Examination.—Anæmic. Local: Ulcerated rough area close to anus constricting gut.

Operation.—August 7, 1901. Sims's position. Kraske. Sphincter and anus excised, coccyx removed; gut, including mass (six inches), excised. End of gut twisted and sutured to wound. Hæmorrhage slight.

Postoperative.—Discharge yellow, odor strong.

Discharged cured, September 25, 1901.

Patient doing fairly well; weighs twenty-five pounds more

than before operation. Discharge from wound still present. No control over defecation.

CASE 33.—L. D. G., aged forty-four years; male; white. New York Hospital, Dr. Weir. Adenocarcinoma.

Family History.—Negative for neoplasm.

History.—Two months previous to operation began to have dull aching pain at defecation, with passage of small amounts of blood in stools. No loss of flesh or strength. Bowels regular.

Physical Examination.—Ulcerated, indurated mass one inch above anal margin, extending up two and one-half inches, involving one-third circumference of rectal wall.

Operation.—Colostomy, April 25, 1898. May 12, 1898. Sims's position. Median perineal incision. Lower three inches of rectum excised. Free end sutured to upper angle of skin wound.

Postoperative.—Artificial anus, May 28, 1898. Discharged, improved, June 30, 1898. Not reported later.

CASE 34.—I. C., aged fifty-five years; male; white; engineer. Presbyterian Hospital, Dr. Eliot. Carcinoma.

Family History.—Negative for neoplasm.

History.—Good health until one month previous to operation; became very constipated. Used Sal Rochelle, Liq. Mag. Cit., Castor Oil, and enemata with but little result. By persistent catharsis had two or three stools during the month. Stools were fluid (otherwise not noted). Considerable prostration.

Physical Examination.—Well nourished, not anæmic. Mass on right side of rectum can be touched by finger; limits not definable.

Operation.—Previous colotomy, July 24, 1898. September 7, 1898. Sims's position. Sacral flap, with division of sacrum between fourth and fifth segments. Mass size of small orange removed (four inches above anus). End-to-end suture of gut.

Postoperative.—Considerable discharge from wound of pus and mucus. Healing by granulation. Belladonna and opium suppositories for pain. Discharged cured, October, 1898.

Died March 18, 1900, from pneumonia. Never regained control over bowels.

CASE 35.—M. M., aged seventy years; female; white; housewife. Presbyterian Hospital, Dr. Briddon. Malignant adenoma.

History.—Began two years previous to operation with difficulty at stool. Fæces passed in small particles, accompanied by blood and bearing-down sensation. Dull ache in rectum before defecation. Frequency of defecation; improved under treatment. Loss of strength and twenty pounds weight.

Physical Examination.—Moderately well nourished, skin and mucous membrane of good color. Local: Indurated, raspberry-like mass encircling gut two inches from anus; no ulceration; no glandular involvement.

Operation.—October 31, 1903. Prone position. Median incision. Excision of coccyx, sacrum, and gut containing tumor; end-to-end suture of gut.

Discharged cured, December 28, 1903.—"Granulations have tendency to be sluggish." Recurrence; returned to hospital.

Physical Examination.—General condition good. Robust, complexion ruddy. Local: Large mass encircling rectum one and one-half inches deep.

Operation.—May 23, 1904. Dr. Johnson. Mass excised. Rectum sutured to sacral end of skin wound.

Discharged, improved, June 13, 1904.

Has been in bed over four months, cannot sit up because wound pains her so. Wound does not heal. Has no control over bowel. No return noticeable. Has suffered since operation with la grippe, dysentery, and dyspepsia.

CASE 32.—A. B., Brooklyn; aged forty-nine years; female; white; seamstress. New York Hospital, Dr. Bolton. Carcinoma.

Family History.—Negative for neoplasm.

History.—Habitual constipation. Four months previous to operation, experienced painful defecation. Constipation severe; soon after blood in stools; stools small. Lost twenty pounds. Indigestion marked.

Physical Examination.—Anæmic. Local: Ulcerated rough area close to anus constricting gut.

Operation.—August 7, 1901. Sims's position. Kraske. Sphincter and anus excised, coccyx removed; gut, including mass (six inches), excised. End of gut twisted and sutured to wound. Hæmorrhage slight.

Postoperative.—Discharge yellow, odor strong.

Discharged cured, September 25, 1901.

Patient doing fairly well; weighs twenty-five pounds more

than before operation. Discharge from wound still present. No control over defecation.

CASE 33.—L. D. G., aged forty-four years; male; white. New York Hospital, Dr. Weir. Adenocarcinoma.

Family History.—Negative for neoplasm.

History.—Two months previous to operation began to have dull aching pain at defecation, with passage of small amounts of blood in stools. No loss of flesh or strength. Bowels regular.

Physical Examination.—Ulcerated, indurated mass one inch above anal margin, extending up two and one-half inches, involving one-third circumference of rectal wall.

Operation.—Colostomy, April 25, 1898. May 12, 1898. Sims's position. Median perineal incision. Lower three inches of rectum excised. Free end sutured to upper angle of skin wound.

Postoperative.—Artificial anus, May 28, 1898. Discharged, improved, June 30, 1898. Not reported later.

CASE 34.—I. C., aged fifty-five years; male; white; engineer. Presbyterian Hospital, Dr. Eliot. Carcinoma.

Family History.—Negative for neoplasm.

History.—Good health until one month previous to operation; became very constipated. Used Sal Rochelle, Liq. Mag. Cit., Castor Oil, and enemata with but little result. By persistent catharsis had two or three stools during the month. Stools were fluid (otherwise not noted). Considerable prostration.

Physical Examination.—Well nourished, not anæmic. Mass on right side of rectum can be touched by finger; limits not definable.

Operation.—Previous colotomy, July 24, 1898. September 7, 1898. Sims's position. Sacral flap, with division of sacrum between fourth and fifth segments. Mass size of small orange removed (four inches above anus). End-to-end suture of gut.

Postoperative.—Considerable discharge from wound of pus and mucus. Healing by granulation. Belladonna and opium suppositories for pain. Discharged cured, October, 1898.

Died March 18, 1900, from pneumonia. Never regained control over bowels.

CASE 35.—M. M., aged seventy years; female; white; housewife. Presbyterian Hospital, Dr. Briddon. Malignant adenoma.

Family History.—Negative for neoplasm.

History.—Began one year previous to operation with constipation, straining and pain at stools. Considerable loss of weight and strength.

Physical Examination.—Well nourished. Small cauliflower growth size of walnut projecting from anus; another smaller mass two inches from sphincter.

Operation.—September 29, 1897. Lithotomy. V-shaped incision including anus and vulva as high as meatus urinarius. Posterior vaginal wall involved in mass. Inguinal glands not enlarged. End of gut excised. Wound closed with silkworm gut. Hæmorrhage moderate. Discharged cured, October 15, 1897. Function good.

Admitted June 7, 1900, to Home for Incurables.

Physical Examination.—Hard mass in rectum occluding lumen.

Died November 3, 1900, from recurrence.

CASE 36.—C. S., aged sixty-seven years; female; white. New York Hospital, Dr. Bolton. Adenocarcinoma.

Family History.—Negative for neoplasm.

History.—More or less dysentery for last sixteen years. For a few years previous to operation alternated with constipation, and noticed a small amount of blood in stools. Four or five months previous to operation had considerable bearing-down pains, particularly when bowels moved. Severe hæmorrhage one week before operation. Some loss of weight and strength.

Physical Examination.—Poorly nourished, anæmic. Local: On posterior wall, one inch from anus, is a tumor projecting forward three-quarters of an inch, surface uneven, ragged, firm consistency, one and one-half by two inches. No glandular enlargements felt.

Operation.—August 10, 1901. Sims's position. Median incision from anus upward. Elliptical area bearing tumor removed. Cut edges of rectum and sphincter joined. Wound through skin left open. Hæmorrhage slight.

Postoperative.—Uneventful. Discharged cured, September 29, 1901.

Alive and well, February, 1905. Has perfect control over action of bowels.

CASE 37.—J. D., aged fifty-two years; male; white; laborer.

New York Hospital, Dr. Murray. Adenocarcinoma—rectum and glands.

Family History.—Negative for neoplasm.

History.—Began about nine months previous to operation with blood in stools. One month after passage of blood had pain in the hips, pain constant and "bursting" in character. Pain and amount of blood in stool increased with time. More diarrhœa than constipation. Became too weak to work. Lost twenty pounds in two and a half months.

Physical Examination.—Alcoholic, emaciated. Inguinal glands enlarged. Rectal: Just within the anus, extending up two and one-half inches, an ulcerating growth involving one-half circumference of gut; edges hard.

Operation.—Preliminary colostomy, March 29, 1904. April 9, 1904. (*a*) Incision encircling anus; coccyx removed, mass excised, wound closed with deep suture. (*b*) Inguinal glands of right side excised. May 9, 1904. Excision of metastatic inguinal gland on right side, under cocaine. Discharged, improved, May 30, 1904.

February 15, 1905. In Metropolitan Hospital, described as "having lumps breaking out on legs." One leg much swollen. There is a general recurrence in pelvis. Has very fair control through colostomy anus.

Case 38.—J. W., aged forty-three years; married; male; white; bartender. Presbyterian Hospital, Dr. Woolsey. Malignant adenoma.

Family History.—Negative.

History.—Always very constipated, two to three days. No neoplasm elsewhere. Blood in stool two months before admission (July 4, 1901), only with defecation, no pain. One month, pain with defecation localized in rectum, not referred, bleeding with and without defecation, amount increasing. No obstruction. Can only urinate after defecation.

Physical Examination.—General: Fairly well nourished, somewhat anæmic, otherwise negative. Local: Uneven villous-like growth just within sphincter all over rectum except left side. Seems continuous with prostate on right. Right lobe of prostate nodular and firm. Tumor hard, bare, infiltrated, smooth, irregular, not tender.

Operation.—September 11. (Inguinal colostomy, September

4.) Position right lateral. Coccyx and sacrum at level of third foramen removed. Much hæmorrhage. Rectum freed and resected from between external and internal sphincters to an inch above growth. Peritoneum stripped up. Silk retention sutures passed through proximal end before cutting slit in posterior surface of rectum. Sponges inserted. Rectum cut. Fat and lymph nodules cleaned from pelvis. Proximal end sutured by mucous membrane to anus, connective tissue to sphincter. Wound packed with gauze. Rectum closed at colostomy wound by gauze in distal end. Condition good.

Postoperative.—Bowels moved by colostomy wound on third day, by anus on sixth day. Sutures separated and rectum retracted two inches by the fourteenth day. Sacral wound closed clean by granulation at end of four months. Complications, attack of diarrhœa with pain on two occasions. Fæcal discharge from sacral wound for many weeks following operation. Discharged January 14, 1902, with occasional fæcal discharge from colostomy wound, and granulating sinus one inch deep and three-quarters by one-half inch, through which about one-half fæcal matter is discharged. Gained ten pounds in weight.

March 1, 1905. The sacral wound and rectal opening have entirely healed, so that all movements come through the colostomy wound. He has very fair control over this. It shows a tendency to stricture, which is controlled by bougies passed once a week.

Case 39.—M. C., aged forty-five years; male. Bellevue Hospital, Dr. Woolsey. Pathological Report, Adenocarcinoma.

Family History.—No malignancy.

History.—For more than a year prior to operation he had pain due to fissure. For six months pain had been severe, and he had noticed blood in stools. There was no loss in weight or strength and no impairment of general health.

Physical Examination.—November 28, 1904, general condition good. Local: A fissure in ano is present. At finger length up in rectum there is a growth (nature of this not noted). December 1, 1904. Lateral colostomy.

Operation.—December 28, 1904. Incision over sacrum, coccyx, and into perineum. Coccyx and left side of third lower sacral vertebra removed. Rectum freed and three inches, including growth, resected. End-to-end suture, leaving anal sphincter intact.

Postoperative.—Wound badly fouled with fæces, marked sloughing. Retraction of sutured gut and gaping of wound. March 15, 1905, still in hospital. Has involuntary defecation through both wounds. Posterior wound not yet healed.

CASE 40.—W. R., aged sixty-nine years; male; white; painter. Presbyterian Hospital, Dr. McCosh. Pathological Report, Adenocarcinoma.

Family History.—Negative for neoplasm.

History.—Hæmorrhoids to a certain extent. Six months ago (April 16) first noticed involuntary watery discharge from anal orifice, no blood nor pain. One week ago blood in stools. Examined by physician. Ulcer of rectum. Operation advised. No loss of weight, pain or bladder disturbance.

Physical Examination.—General: Well nourished and in good health. Local: Prostate enlarged. On posterior wall an irregular projecting cauliflower-like mass extending into lateral walls in crescentic manner, firm. Examining finger returns bloody.

Operation.—No previous colostomy. October 20, modified Kraske. Sims's position (on right side). Removal of coccyx and lower half of sacrum. Hæmorrhage free but not excessive, peritoneum not opened. Involved glands and fat removed. Six inches of rectum removed. Proximal end sutured to upper end of wound. Large drainage-tube inserted. Time, one hour, ten minutes. Condition excellent.

Postoperative.—Bowels constipated by Pil. Opii. Wound dressed on second day, clean. Considerable oozing. Bowels moved on seventh day. Catheterized for thirty days. No cystitis.

General progress excellent, gained in weight and flesh. Discharged December 3. Sacral wound nearly closed; granulating area three-quarters of an inch deep.

March 1, 1905. No recurrence. Has no fæcal control and is very despondent, threatening suicide. Sacral sinus still persists.

CASE 41.—W. I., aged seventy years; male; white; mason. Presbyterian Hospital, Dr. McWilliams. Pathological Report, Adenocarcinoma.

Family History.—Negative for cancer.

Previous History.—Negative for rectal conditions.

Initial Symptoms.—Three years ago (1901) noticed some

blood in stools, soon followed by constipation, requiring constant catharsis. Without cathartic goes three or four days, but constant desire. At times a pint of clotted blood. No pain, vomiting, or bladder trouble. Gradual increase in bleeding and constipation. Fifty pounds lost in three years.

Physical Examination.—General: Obese and florid, otherwise negative. Local: One finger's length above anal orifice a hard, crater-like mass in posterior wall, slightly movable, friable, seems attached to sacrum. Markedly encroaching on lumen of rectum. No glands felt.

Operation.—June 22, 1904. Quarter grain morphine before operation. Position, knee-chest. Removal of coccyx and one inch of sacrum. Total resection of rectum, burned through with cautery. Hæmorrhage moderate, controlled by clamps and hot saline. Proximal end could not be drawn down, so was closed with plain gut and droppped back into wound, which was packed with gauze and rubber tube. Lateral inguinal colostomy.

Postoperative.—Sacral wound suppurated profusely, discharge foul and fæcal. Upper sutures did not hold. Considerable bloody oozing. Colostomy wound in good condition. Sphincteric action poor. Had to be catheterized first thirty-six hours. Later, occasional fæcal discharge through sacral wound. After first week a septic temperature, profuse purulent discharge from sacral wound. At end of one and a half months from operation patient is still discharging some fæcal matter from sacral wound. September 30, 1904. Secondary colostomy, by intermuscular method; with band of external oblique fascia as constricting sphincter, completely cutting off portion of gut distal to colostomy opening. Following this the sacral wound healed in rapidly by granulation. No more fæcal discharge. Discharged, December 17, with an imperfect sphincteric action of colostomy and small granulating area in sacral wound. General condition good.

March 15, 1905. He is in good health, and enjoys good control over the action of the colostomy anus. There is a tendency to contraction of the skin orifice around the gut end. This is corrected with bougies.

CASE 42.—J. K., aged forty-four years; male; German; was admitted to the French Hospital, Dr. Peck, May 29, 1897, with a history of pain on defecation dating back fifteen months. Later, constipation, blood in stools, loss of flesh and strength; for six

months unable to sit in chair on account of pain. For fourteen days prior to admission had had no passage of fæcal matter or gas; intense pain and continuous vomiting for several days. Abdomen was greatly distended and tense, pulse rapid and feeble, expression anxious, skin cool and cyanotic. Large constricting neoplasm of rectum felt about four inches from anus.

Inguinal colostomy by lateral adhesion performed immediately (May 29, 1897); patient rallied rapidly, and insisted on an operation for removal of the growth in spite of an unfavorable prognosis.

Kraske's operation performed July 16, 1897, with removal of three and one-half inches of bowel and several very much enlarged sacral glands. About one inch of anal portion of gut preserved and upper segment sutured to it; sphincter divided posteriorly. Wound healed with very moderate sepsis, although the colostomy opening failed to divert the fæcal current from the lower bowel; some of the posterior stitches gave way.

Plastic operation to close posterior defect in rectum, October 27, 1897, partially successful, final result being very fair sphincteric control, with only from two to four evacuations daily.

Closure of inguinal colostomy by suture February 17, 1898; healing by primary union. Condition quite comfortable for nearly two years; local recurrence, quite extensive, noted July 31, 1899; marked pain and cachexia noted October 27, 1899; cachexia progressive, and severe pain from then to death, three years after the radical operation. The closure of the colostomy opening on February 17, 1898, was permanent, and there was never any return of obstruction.

CASE 43.—K. D., aged thirty-nine years; female. Presbyterian Hospital, February 10, 1905, Dr. McCosh. Adenocarcinoma.

Family History.—Negative for neoplasm.

History.—Troubled with bleeding from hæmorrhoids(?) for fifteen years. During three months prior to operation she suffered pains in rectum and increasing constipation. No bleeding during this time.

Physical Examination.—General condition good, showing no cachexia. Local: There is a rough, indurated mass two and one-half inches up, infiltrating the posterior and right rectal wall; upper limit not determined.

Operation.—No preliminary colostomy. Sims's position on right side. Incision downward from lower sacrum over coccyx into perineum. Examination showed sphincters could not be saved. Lower sixth of rectum was amputated, end sutured to upper angle of wound. An attempt to pass bowel through gluteus failing because of difficulty in bringing it down.

Postoperative.—Wound became fouled with fæces. Gut tore away and retracted two inches. Patient was quite septic for three weeks. Had no control over movements. At present, March 16, one month after operation, there is a large granulating cavity in sacral region, with rectum two inches deep in it, from which involuntary defecation takes place. General condition good.

CASE 44.—S. R., aged forty-eight years; male; colored. Lincoln Hospital, Dr. Hartwell. Carcinoma.

Family History.—Tubercular; no malignancy.

History.—In 1899 he had an ischiorectal abscess which healed without treatment. Recurred in 1901, and was operated on. Shortly after this he began to suffer from some rectal tenesmus and incontinence, which have grown continually worse. For some months past there has been a purulent discharge from the rectum, and his general condition has failed. During the past month he has lost thirty-five pounds in weight. His general condition on admittance to the Lincoln Hospital on May 9, 1904, was poor. He was very anæmic and moderately emaciated. Rectal examination showed an indurating tumor which encroached on the sphincter and extended upward, involving the greater part of the rectal wall for a distance of three inches. The sphincteric control was completely lost, and the growth apparently had its origin in the tract of the old abscess.

Operation.—May 23, 1904. Colostomy. Intermuscular method, proximal end beneath anterior sheath of rectus muscle and out at midline. Distal end sutured in primary wound. Healed kindly. Had fair control over movements. General condition improved.

June 21, 1904. Exaggerated knee-chest position. Incision from lower sacrum downward surrounding the anus. Resection of coccyx and one-half sacral segments. Rectum closed below. Freed from its bed, dissected off prostate and bladder and drawn out about eight inches. Amputated between two ligatures and proximal end closed. Wound partly sutured and drained with gauze. Shock very moderate.

June 29, the wound healed kindly with very little discharge. Patient gradually lost strength, however, and died from lack of power to react, a condition often noted in colored patients. There was neither local nor general evidence of sepsis.

CASE 45.—J. E., aged thirty-seven years; male. Lincoln Hospital, Dr. Lambert. Carcinoma.

In June, 1903, began to suffer from increasing constipation and pain about rectum. In the summer of 1904 blood appeared in stools. Entered Lincoln Hospital, October 20, 1904.

Physical Examination.—Some emaciation. Rectal: A finger's length from the anus there is a constriction, which just admits tip of finger and due to an indurating growth involving entire wall and circumference of rectum. October 27. Radical removal of the growth through a perineal incision with splitting of the anus, but without removal of the sphincter. About eight inches of rectum was resected and the proximal end sutured to anal margin; wound then partly closed with drainage.

November 4. Failure of union in sutured gut. Fouling of whole wound with fæces. General condition of sepsis. To correct these conditions, an inguinal colostomy was done by intramuscular method, using rectus muscle and its anterior sheath as a sphincter. Following this the sacral wound cleared and healed kindly.

March 22, 1905. He is in excellent condition. He has very fair control over movements through colostomy anus, and is gaining constantly in this respect. Is filling position as engineer in large factory.

CASE 46 is reported in full in record of cases presented at the New York Surgical Society, for which see page 275.

SUMMARY AND CONCLUSIONS.

Number of cases, 46,—26 males, 20 females. Youngest, 23 years; oldest, 70 years (2 cases).

In the third decade, 5 cases; in the fourth decade, 9 cases; in the fifth decade, 14 cases; in the sixth decade, 11 cases; in the seventh decade, 5 cases; in the eighth decade, 2 cases.

Results.—Died from operation, 12 cases, or 26 per cent., 7 dying from infection, *i.e.*, 58 per cent. of all the deaths.

Died from recurrence in less than two years and more

TABLE OF

Number. Name. Operator. Hospital.	Age.	Sex.	Histological Structure.	Nature of First Symptoms and Duration of Disease.	Local Condition.	Cachexia.	Inguinal Colostomy.
No. 1. I. S. Dr. Bolton, New York.	34	F.	Adenocarcinoma.	Bleeding and pain; 4 months.	Nearly impassable stricture 3½ inches from anus.	No.	Lateral.
No. 2. K. Dr. McCosh, Presbyterian.	46	F.	Malignant adenoma.	Bleeding, diarrhœa; 9 months.	Not stated.	.....	No.
No. 3. F.L. Dr. Tilden Brown, Presbyterian.	25	M.	Adenocarcinoma.	.....	.....	.....	No.
No. 4. J.M. Dr. McCosh, Presbyterian.	56	M.	Carcinoma.	Bleeding, increasing diarrhœa and pencil stools; pain. 9 months.	Hard, ragged mass on anterior wall, 1½ inches from anus.	.....	No.
No. 5. M.W. Dr. Hartley, New York.	23	M.	Gelatinous carcinoma.	Tenesmus, mild bleeding, constipation, diarrhœa, 1 month; history of perineal trauma 10 years previous, followed by bleeding.	Tight ring 1½ inches from anus. Second ring ½ inch higher. Bleeding free from examination.	.....	Lateral (?) for obstruction at suture site, 3 months after radical operation.
No. 6. P.W. Dr. Tilton, Bellevue.	42	M.	Carcinoma clinically.	Constipation progressing over period of 5 years.	Hard, nodular growth obstructing rectal lumen.	No.	No.
No. 7. J. M. G. Dr. Hartwell, Bellevue.	60	M.	Carcinoma.	Pain for 6 months; bleeding. 4 months.	Hard, friable growth, 1½ inches from anus. Lumen much constricted. Inguinal glands enlarged and hard.	Yes.	Complete, with both ends in parietes. Proximal end beneath sheath rectus.
No. 8. F.S. Dr. Eliot, Presbyterian.	60	F.	Malignant adenoma.	Pain and difficult defecation for 2 years; bleeding.	Internal hæmorrhoids. Hard nodules surrounding gut at internal sphincter.	Yes.	No.
No. 9. A.R. Dr. Murray, New York.	49	F.	Carcinoma.	No symptoms except constipation, which was habitual until 1 month prior to operation, when obstruction to enema nozzle was noted.	Nodular mass completely surrounding gut in region of sphincter. Extrarectal tissue involved.	No.	No.
No. 10. C.M.M. Dr. Hartwell, Bellevue.	27	F.	Carcinoma.	Bleeding and pains for few months.	Encircling friable mass 3 inches from anus. Caliber gut nearly occluded. Bleeds easily. Upper limit not reached.	Marked.	Complete as to temporary anus. Both ends in wound.
No. 11. A. W. Dr. Briddon, Presbyterian.	58	F.	Malignant adenoma.	Pain and bleeding, 9 months; hæmorrhoids 12 years ago.	Tumor size hen's egg above internal sphincter.	.....	No.
No. 12. R. H. Dr. Weir, New York.	58	M.	Carcinoma.	Bleeding and pain, constipation; 1 year. Treated for hæmorrhoids.	Large mass 2 inches above anus extending entirely around gut.	.....	Lateral 2 weeks prior to resection.

CASES.

Type of Radical Operation.	Postoperative History.	Result and Time in Hospital.	Late Results.	Remarks.
Sacral route. 4 inches resected. End-to-end suture.	Fæces through both ani. Suppuration and sepsis.	Lower wound granulating; 3 months.	1 year general condition good. Fair function through colostomy. Anal fistula open.	Had second operation, nature not known.
Perineal route. Removal coccyx. 10 inches resected. End-to-end suture 1½ inches up.	Contraction caused stricture. Dilated.	"Improved;" 4½ months.	Died. Date not determined.	The course of wound healing is not given.
Sacral route. Resection and end-to-end suture.	.....	Healed; 1 month.	Died soon after leaving hospital.	Recurrent operation. The first 4 years earlier. Details not known.
Perineal route. Coccyx resected. Amputation of distal segment, proximal sutured to perineum.	.....	Died on third day.	....	.....
Kraske. 3 months later division of recurring stricture and colostomy.	Slowly granulating sacral wound.	Discharged improved in 3 months.	Died short time later.	Recurrence was evidently early.
Sacral route. Resection rectum at site of growth and sutured the proximal end to anal mucous membrane. Sacral gland removed.	.....	Healed. Left hospital in 3 months.	Alive and healthy at present, 11 months after operation. Bowels under partial control, though often involuntary. Stricture at gut union which required section 1 week ago. Bowels less controlled since.	Note tendency to stricture when anus is so arranged as to give fair control.
4 weeks later sacral route. Amputation, 6 inches, including anus; glands and areolar tissue removed *en masse*; end sutured and dropped in pelvis.	Primary union except at drain point. No suppuration.	Complete healing in 3 weeks. Discharged in 1 month.	8 months, no return. Colostomy with excellent control.	Inguinal gland removed for examination showed no cancer.
Kraske method.	Marked suppuration and sloughing.	Died in 3 weeks from chronic sepsis and inanition.	.....	Very advanced case in patient of poor resistance.
Perineal method. Amputation, including anus. Gut sutured to skin. Some growths left in soft parts (?).	Clean healing by granulation.	Discharged in 1 month. Healed.	Died from recurrence in 22 months. Excellent sphincteric control.	Note control in absence of muscles.
Sacral route 10 days later. 4 inches of gut resected, leaving sphincters. Proximal end to anal by suture. Much shock.	Rested poorly. Progressive weakness. Only slight suppuration, but evidence of sepsis.	Died in 6 days without any good reaction after operation. Sepsis to some extent.	....	Patient showed poor resistance after colostomy. Radical operation done too soon after colostomy.
Sacral route. Resection with end-to-end suture.	Much infection in wound. Peritonitis (?).	Died on fourth day from sepsis.	....	.....
Sacral route. 6 inches resected, saving sphincter. End-to-end suture.	Much fæcal leakage in wound.	Died on fourth day probably from shock and sepsis.	.....	.....

TABLE OF

Number. Name. Operator. Hospital.	Age.	Sex.	Histological Structure.	Nature of First Symptoms and Duration of Disease.	Local Condition.	Cachexia.	Inguinal Colostomy.
No. 13. F. N. Dr. Weir, New York.	52	M.	Carcinoma.	Bleeding and pain; 9 months.	Hard, nodular, bleeding mass encircling rectum from 1 inch above anus as high as finger can reach.	.....	Yes. 16 days before resection.
No. 14. I. M. Dr. Markoe, Dr. Hartley, New York.	37	F.	Adenocarcinoma.	.....	Large mass on rectum on Douglas's pouch.	Yes.	No.
No. 15. T. B. Dr. Hartley, New York.	33	M.	Carcinoma.	Pain, constipation. Treated for hæmorrhoids; 4 months.	Mass 4 inches from anus attached around lumen of gut.	No.	No.
No. 16. M. R. Dr. Johnson, New York.	53	F.	Carcinoma.	Discomfort and increasing rectal obstruction for 9 months.	Rectum completely occluded just above sphincter by mass which bulges into vagina.	No.	No.
No. 17. W. F. Dr. Woolsey, Presbyterian.	52	M.	Epithelioma.	Syphilitic. Specific ulcers around anus for 4 years.	Mass in right anterior rectum size of chestnut. Surface uneven, growth superficial.	Moderate.	No.
No. 18. J.S. Dr. Briddon, Presbyterian.	49	M.	Adenocarcinoma.	Bleeding and pain; 1 year.	Hard, indurated tumor 1 inch from anus on left rectal wall. Sphincter involved. Large prostate.	.....	No.
No. 19. A. M. Dr. Briddon, Presbyterian.	53	F.	Malignant adenoma.	Bleeding, pus, diarrhœa; 6 months.	Nodular mass extending two-thirds around rectum on left side.	.....	No.
No. 20. J.M. Dr. Eliot, Presbyterian.	47	M.	Adenocarcinoma.	Obstruction to defecation, bleeding; 6 months.	Hard, fixed, fungating mass just above anus size of plum. 4 inches from anus a hard, annular stricture, adherent to bladder.	No. Well nourished.	No.
No. 21. J.G. Dr. Hartley, New York.	59	M.	Adenocarcinoma.	Old history of hæmorrhoids. Constipation, free bleeding, pus several months.	.....	Yes.	Lateral.
No. 22. J.M. Dr. McCosh, Presbyterian.	63	M.	Carcinoma.	Diarrhœa, tenesmus, involuntary fæces.	Mass 3 inches from anus.	?	No.
No. 23. M. C. Dr. Hartley, New York.	44	F.	Adenocarcinoma.	Suffered 1 year, then colostomy as palliative.	Cauliflower mass 2 inches from anus encircling entire gut.	.....	Lateral 17 months before resection as palliative.
No. 24. C. H. Dr. McCosh, Presbyterian.	35	F.	Adenocarcinoma.	Bleeding and pain; 9 months.	Area of ulceration size of silver dollar 2 inches above external sphincter. No stricture.	No.	No.
No. 25. L. M. Dr. McCosh, Presbyterian.	34	M.	Malignant adenoma.	Bleeding and mucous discharge, 1 year; pain; 11 months.	Cauliflower growth over 4 inches of rectum above anus adherent to prostate and bladder.	Yes.	Yes.

CASES—*Continued.*

Type of Radical Operation.	Postoperative History.	Result and Time in Hospital.	Late Results.	Remarks.
Sacral route. Resection. Marked shock and hæmorrhage.	.....	Died on following day without reaction.	.....	.....
Abdominal route. Mass removed.	Had recovered in one month. Second operation for removal failed to heal.	Died in 3 months. Fæcal sinus remaining open.	.....	Probably primary in pelvic tissue following extensive adnexa inflammation.
Coccyx removed. Perineal route. Resection growth. End-to-end anastomosis.	Did not react well.	Died following day from shock.	.....	.....
Perineal route. Amputation of lower 5 inches of gut. End sutured in skin.	Extensive fouling of wound with fæces. Much suppuration and general sepsis.	Died in 16 days from sepsis.	.....	Marked extra-rectal involvement, but growth was entirely removed.
Excision of mass and suture of mucous membrane above to skin. Sphincter not removed.	Healed promptly.	Discharged in 10 days.	Well after 33 months. No return of growth. Complete control of bowels.	Growth was in mucous membrane only. Similar tumor clinically had healed with mixed treatment.
Perineal incision. Resection of 3 inches of bowel and gut sutured to skin.	Much infection. Cystitis. Healing fair.	Discharged in 3½ months. Healing incomplete and involuntary defecation.	Died 4 months after operation. Never really recovered. No sphincter action.	.....
Sacral route. Amputation of lower part of rectum. End sutured in sacral wound.	Wound infected. Suppuration marked.	Discharged in 2 months. No control over bowel.	Recurrence in 4½ months. Died in 16 months. No control over bowels regained.	Lived 1 year after recurrence was noted.
Sacral route. Amputation of 4 inches of rectum. End sutured to upper angle wound.	Fæcal fouling of wound. Urinary fistula developed. Suppuration.	Discharged in 2 months, having incontinence of fæces and urine.	Died in 12 months without regaining any control over sphincter. Confined to bed all the time.	Growth evidently involved outer coats of bladder.
Perineal route. Coccyx removed. Excision lower end of rectum. End sutured to skin.	Shock. Sepsis? Abdominal pain.	Died on tenth day from sepsis probably.	....	.....
Sacral route. Resection segment of rectum. Proximal end sutured in sacral wound. Lower segment clamped.	Marked fouling of wound. Free suppuration.	Died on 23d day from shock and sepsis.	.....	Hæmorrhage very severe, so that patient's condition prevented end-to-end closing of rectum.
Sacral route. Mass resected. End-to-end anastomosis.	Considerable discharge from wound.	Discharged in 6 months with wound in good condition.	Died in 13½ months. Control over bowels fair. Could attend to social duties. Developed dropsy before death.	Growth considered inoperable when colostomy was done. Radical removal 17 months later. Lived 13 months more, *i.e.*, 30 months after colostomy.
Coccygeal and perineal route. 6¾ inches amputated. Proximal end sutured to skin. Glands involved.	Wound became contaminated with fæces. Slow in healing.	Discharged in 5 weeks. Wound still open. Incontinence of fæces.	Died in 15 months. Never regained control over bowels. Died from asthenia. Recurrence not known.	.....
Perineal route. Amputated 10 inches of rectum. End sutured into skin wound.	Posterior wound healed kindly.	Discharged in 6 weeks. Colostomy anus open. Control not mentioned.	Died in 6 months, "never having recovered."	Colostomy apparently prevented infection in lower wound.

TABLE OF

Number. Name. Operator. Hospital.	Age.	Sex.	Histological Structure.	Nature of First Symptoms and Duration of Disease.	Local Condition.	Cachexia.	Inguinal Colostomy.
No. 26. J. R. Dr. Murray, New York.	35	M.	Colloid carcinoma.	Bleeding, pain, constipation; duration not given.	Posterior and to left hard, flat growth just reached by finger.	Yes.	No.
No. 27. J. M. D. Dr. Tilton, Bellevue.	45	F.	Carcinoma.	Old history of pruritis ani; bleeding only 10 days prior to operation.	.....	Moderate.	No.
No. 28. M. R. Dr. Hartley, New York; Dr. Brown, Presbyterian.	47	F.	Adenocarcinoma; recurrence same.	Bleeding and pain; 2 years.	Ring of villous growths constricting lumen 3 inches from anus.	No.	No.
No. 29. W. P. Dr. McCosh, Presbyterian.	27	M.	Adenocarcinoma.	Bleeding and pain; 2 years.	Ulcerated mass on left side low down.	No.	No.
No. 30. M. J. Dr. Markoe, New York.	39	F.	Adenocarcinoma.	Bleeding, 8 months; partial obstruction for 4 months.	Ulcerating mass on anterior rectal wall 1½ inches in diameter.	No.	No.
No. 31. B. R. Dr. Stimson, New York.	56	F.	Adenocarcinoma.	Bleeding, pain, irregular action of bowels; 2 years.	Hard mass encircling gut 2 inches from anus. No ulceration.	Moderate.	No.
No. 32. A. B. Dr. Bolton, New York.	49	F.	Carcinoma.	Habitual constipation; pain and bleeding; 4 to 3 months.	Ulcerated, rough area close to anus, constricting gut.	Moderate.	No.
No. 33. L. D. G. Dr. Weir, New York.	44	M.	Adenocarcinoma.	Pain and bleeding; 2 months.	Ulcerated, hard mass from 1 to 3½ inches from anus over one-third bowel circumference.	No.	Yes, as preliminary.
No. 34. I. C. Dr. Eliot, Presbyterian.	55	M.	Carcinoma.	Constipation almost complete, extending over only 1 month. No other symptom.	Mass on right side of rectum just reached by finger.	No.	Yes, lateral, 6 weeks prior to radical operation to relieve obstruction.
No. 35. M. M Dr. Briddon, Presbyterian.	70	F.	Malignant adenoma.	Constipation and pain; 1 year.	Small cauliflower growth projecting from anus. Second mass 2 inches from anus.	No.	No.
No. 36. C. S. Dr. Bolton, New York.	67	F.	Adenocarcinoma.	Diarrhœal tendency for several years prior to operation. Occasional bleeding. Pain marked; 4 months.	Tumor on posterior wall 1 inch from anus. ¾ inch thick by 1½ and 2 inches, ragged, firm.	Yes.	No.

CASES—*Continued.*

Type of Radical Operation.	Postoperative History.	Result and Time in Hospital.	Late Results.	Remarks.
Coccygeal and perineal route. 4 inches of gut amputated. End sutured to angle of wound.	Healing rather prompt and without much suppuration.	Discharged in 7 weeks. Wound healed and condition good.	Growth recurred in few months, and he died in less than a year.	Very extensive condition. Growth had been removed year prior to this operation, but not radically. Benign (?) Sacrum was involved at time of radical operation.
Sphincter split. Lower 2 inches of rectum amputated together with growth. Gut sutured to skin.	Healed with very little suppuration.	Discharged in 10 weeks with complete healing of wound.	Good condition at present, 6 months. Fair sphincteric control, though cannot retain fæces when desire to defecate arises.	.....
Kraske. Resection of piece and end-to-end suture.	Wound healed well and anastomosis united.	Discharged in satisfactory condition in 6 weeks.	Recurrence in 18 months, control having been "fairly good." Recurrence at site of anastomosis. Excised through old sacral wound. Healed kindly. Has fair sphincter control, 26 months after first resection.	Whole history extends over 3½ years. Now has tuberculosis.
Perineal route. 4 inches amputated. End sutured to skin.	Considerable suppuration, but healed well.	Discharged in 1 month with good control.	Growth recurred in 2 months. Excised second time 14 months after operation. Alive and well with good sphincter action after 9 years and 8 months.	Note prompt recurrence and successful removal with permanent cure.
Sacral route. Resection about 3 inches. End-to-end anastomosis.	....	Discharged cured in 11 weeks.	Not heard of after that.	....
Sacral route. Resection. End-to-end anastomosis.	Wound healed slowly and incompletely.	Discharged in 6 weeks.	Recurred locally in few months. Excision; lower end of gut sutured to skin. Living, but in poor condition; involuntary evacuations. 9 months later confined to bed because of weakness and pain.	.....
Kraske. Amputation 6 inches of lower rectum. End twisted and sutured to skin.	Some fouling of wound. Healing, however, satisfactory.	Discharged in 7 weeks. Wound not entirely healed.	In good condition at present, 3½ years later. No sphincter control. Sinus in sacral region still present.	.....
Perineal route. 3 inches of rectum excised. End sutured to upper angle wound.	....	Discharged "improved" in 6 weeks. Colostomy functionating.	Not reported after leaving hospital.	.....
Sacral flap. Resection of mass size of small orange 4 inches up. End-to-end anastomosis.	Infection of wound and free suppuration. Healed by granulation.	Discharged in 6 weeks.	Died of pneumonia (?) 18 months later. No sphincter at anus. Condition at colostomy not noted.	Note lack of sphincteric control even at high resection.
Vaginal and perineal route. Post-vaginal wall and lower end of gut excised. Gut sutured in wound.	Healing satisfactory.	Discharged in 1 month. Function good.	Recurrence locally 33 months later, from which she died 38 months after excision.	Note good function with no anal muscles.
Posterior incision. Growth excised by elliptical incision. Wound in gut closed and sutured to sphincter. Later not disturbed.	Satisfactory. No difficulty in healing.	Discharged in 7 weeks.	Alive and well at present, 4½ years later. Has complete control.	Note permanent cure with comparatively slight operation.

TABLE OF

Number. Name. Operator. Hospital.	Age.	Sex.	Histological Structure.	Nature of First Symptoms and Duration of Disease.	Local Condition.	Cachexia.	Inguinal Colostomy.
No. 37. J.D. Dr. Murray, New York.	52	M.	Adenocarcinoma.	Bleeding, pain, diarrhœa; 9 months.	Just within anus and up for 2½ inches, ulcerating, hard growth, involving one-half gut circumference.	Moderate.	11 days prior to radical operation, intermuscular complete colostomy done.
No. 38. J. W. Dr. Woolsey, Presbyterian.	43	M.	Malignant adenoma.	Habitual constipation. Bleeding and pain; 2 months.	Uneven, villous-like growth just within sphincter, nearly surrounding rectum.	No.	Lateral, 1 week prior to radical operation.
No. 39. M. C. Dr. Woolsey, Bellevue.	45	M.	Adenocarcinoma.	Pain and bleeding for 6 months. Diagnosed as fissure.	Growth high up in rectum. Fissure also present.	No.	Lateral, 1 month prior to radical operation.
No. 40. W. R. Dr. McCosh.	69	M.	Adenocarcinoma.	Loss of fæcal control, 6 months. Bleeding and pain; 1 week.	Irregular, cauliflower mass extending over posterior half of rectal wall above prostate. Bleeds easily.	No.	No.
No. 41. W. J. Dr. McWilliams, Presbyterian.	70	M.	Adenocarcinoma.	Bleeding, constipation. about 2 years.	Finger's length up is hard, crater-like growth on posterior rectal wall. Seems adherent to sacrum.	No.	Lateral at time of radical operation because end could not be drawn into wound. Intermuscular later, with both ends lower segment closed.
No. 42. J.K. Dr. Peck, French.	44	M.	Typical carcinoma.	Pain and constipation for 1 month. Bleeding for over 6 months.	Large, constricting, tumor 4 inches from anus. Complete obstruction for 14 days.	Yes.	Lateral to relieve obstruction. Closed by operation 10 months later.
No. 43. K. O. Dr. McCosh, Presbyterian.	39	F.	Adenocarcinoma.	Hæmorrhoids 15 years. Pain and increasing constipation; 3 months.	Rough, indurated mass 2½ inches from anus.	No.	No.
No. 44. S. R. Dr. Hartwell, Lincoln.	48	M.	Carcinoma.	Old fistula. Purulent discharge and bleeding for several months.	Ulcerating tumor from anus up for 3 inches, surrounding whole rectum.	Yes. Marked.	Complete by intermuscular method under rectal sheath. Distal end in primary wound.
No. 45. J.E. Dr. Adrian Lambert, Lincoln.	37	M.	Carcinoma.	Pain in lower abdomen and increasing constipation for 15 months. Bleeding only 1 month.	Constricting mass 3 inches from anus. Hard, involving thickness of rectal wall.	Moderate.	Yes. Complete. Proximal end under anterior sheath of rectum. Distal end closed 8 days after radical operation to control sepsis below.
No. 46. M. D. Dr. Hartwell. Lincoln.	26	F.	Carcinoma.	Bleeding and pain for 2 years. Interference with parturition. (?)	Complete rupture of perineum. Mass 2 inches from anus, constricting bowel. Whole area badly infected.	Marked.	Complete by open method 9 weeks prior to radical operation.

CASES—*Concluded.*

Type of Radical Operation.	Postoperative History.	Result and Time in Hospital.	Late Results.	Remarks.
Perineal route. Coccyx removed. Excision of rectum and mass. Wound closed. Metastatic glands removed from inguinal region.	Healing of wound apparently good. Colostomy open.	Discharged in 3 weeks, posterior wound having healed.	Alive now 10 weeks after operation, but has general return in pelvis. Colostomy wound gives only moderate control.	Only case reported in which inguinal glands showed involvement.
Sacral route. Resection from external sphincter to 1 inch above growth. End-to-end anastomosis.	Defecation through both ani. Sutures tore and end retracted 2 inches. Wound healed kindly by granulation.	Discharged in 4 months. Bowels moving equally by both paths. No control. Only small sinus leading to sacral end.	Alive and well at present, 3½ years after operation. Fair control through colostomy anus, the sacral wound and anus having closed spontaneously.	Note long period of no recurrence after narrow margin of healthy gut resected; also failure of any function in retained anal sphincter.
Sacral route. Resection 3 inches of bowel without disturbing sphincter. End-to-end sutured.	Marked fæcal fouling of wound, with sloughing and separation of line of union. No general sepsis.	Still in hospital 3 months after operation. Has involuntary movements through both routes.	No recurrence, but local conditions only slowly improving.	Note lack of union and fouling of wound because lateral colostomy does not deflect all fæces.
Sacral route. Amputation of 6 inches of gut. Proximal end sutured in upper angle wound.	Good healing of wound, but constant soiling by fæces.	Discharged in 7 weeks with absolute incontinence.	No recurrence at present, 5 months after operation; sinus persists; no control over defecation.	Patient threatens suicide.
Sacral route. 5 inches amputated, end closed, and dropped into wound.	Distal end open and bowels move through both ani. Wound became fouled and suppurated rather freely. This stopped after complete colostomy was performed 3 months later and healed. There was moderate sepsis.	Discharged after 6 months. Sacral wound healed. Colostomy wound giving very fair control, unless with diarrhœa.	At present, 9 months after radical operation, is in excellent health. Very satisfactory control over inguinal anus.	Note inadequacy of lateral colostomy and rapid healing after complete colostomy.
Kraske. Resection of 3½ inches of gut. End-to-end suture. Sphincter divided, but retained.	Wound healed with moderate sepsis. Some tearing of sutures.	Discharged in 5 months, with wound healed and fair fæcal control.	Remained in good condition for 2 years. Then recurrence locally; died three years after radical operation.	Condition gained markedly after colostomy.
Perineal route. Amputation of 6 inches of rectum. Proximal end sutured in superior angle wound.	Marked fouling of wound. Separation and retraction of rectum. Rather severe sepsis.	Still in hospital 1 month after operation. Incontinence. Wound healing.	.....	.....
Sacral route. Amputation of about 8 inches of gut. Closure lower end of bowel.	No infection in wound.	Died on eighth day from general loss of strength. Wound clean.	Had very fair control over colostomy during 3 weeks after wound healed.	.....
Perineal route. Sphincter split, 6 inches excised. Upper end brought down and sutured through sphincter. Wound partly closed.	Sutures in gut gave way. Gut retracted 2 inches. Wound became fouled and suppurated. Wound gaped. Severe sepsis resulted. Wound healed rapidly by granulation after colostomy.	Discharged with posterior wound nearly healed in 3 months. Fair control over colostomy movements.	Present time, 5 months after operation, in excellent health, working as engineer. Colostomy after removing skin constriction a month ago gives excellent control over movement.	Note failure of union of gut at skin margin; also rapid gain after colostomy.
Sacral route. Amputation of 6 inches of gut and posterior vaginal wall. End left attached in depth of wound.	Long course of chronic sepsis. Wound healed slowly. Marked gain in general condition.	Discharged in 3 months, with posterior wound nearly healed except at upper margin, where cervix uteri projects through.	In good health at present after 11 months. Colostomy gives very good control, permitting her to attend to household work without trouble. Cervix still presenting in wound.	Note good control in simple colostomy.

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Sacral route. Resection 3 inches of bowel without disturbing sphincter. End-to-end sutured.	Marked fæcal fouling of wound, with sloughing and separation of line of union. No general sepsis.	Still in hospital 3 months after operation. Has involuntary movements through both routes.	No recurrence, but local conditions only slowly improving.	Note lack of union and fouling of wound because lateral colostomy does not deflect all fæces.
Sacral route. Amputation of 6 inches of gut. Proximal end sutured in upper angle wound.	Good healing of wound, but constant soiling by fæces.	Discharged in 7 weeks with absolute incontinence.	No recurrence at present, 5 months after operation; sinus persists; no control over defecation.	Patient threatens suicide.
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Sacral route. Amputation of about 8 inches of gut. Closure lower end of bowel.	No infection in wound.	Died on eighth day from general loss of strength. Wound clean.	Had very fair control over colostomy during 3 weeks after wound healed.	.....
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than one, 5 cases, or 11 per cent. (Two in this class may have died from intercurrent disease.)

Died from recurrence in less than three years and more than two, 4 cases, or 9 per cent., and 2 cases in this period who are suffering from extensive recurrence with extreme cachexia, raising the probable per cent. of recurrence death in this class to 13 per cent.

Living more than 3 years: 1 case 9 years, 8 months; 1 case 4 years, 6 months; 2 cases 3 years, 6 months; 1 case 3 years, 2 months. A total of 5.

Living less than 3 years and more than 2, 1 case.

Living less than 2 years and more than 1, 1 case.

Living less than 1 year, 8 cases.

Estimating that one-fifth of these ten cases who have lived less than three years will reach that limit, there are 2 cases to add to the 5 already past that time. Thus, 7 cases based on 44 (2 could not be traced) give the per cent. of estimated cures at 16.

The complete colostomy is a satisfactory method of preventing sepsis, and thus lowering the operative mortality.

Done by the intermuscular method and beneath the rectus sheath, the colostomy gives a better control than does the impaired retained sphincter in most cases.

For complete eradication of the disease, the rectum from above the growth to and including the anus must be sacrificed.

An earlier diagnosis is possible in most cases and will tend to improvement of final results.

CONTUSION AND LACERATION OF THE MUCOUS AND ALAR LIGAMENTS AND SYNOVIAL FRINGES OF THE KNEE-JOINT.

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THE following cases, which have come under the author's observation during the last two years, are reported because the conditions found are of interest in connection with some of the "chronic knees" observed clinically where no history or physical sign points to a lesion that could be detected without opening the joint.

Before giving the histories in detail, it may be well to briefly call attention to the anatomical peculiarities of the structures involved. The accompanying semidiagram illustrates their position. Properly speaking, they are not ligaments, but folds of the synovial membrane containing a varying amount of fat. The mucous ligament is triangular and usually about one and one-quarter inches at the base, which is about opposite the middle of the ligamentum patellæ on the synovial membrane. The apex is attached in the intercondylar notch, and varies from a thread-like structure consisting of but two layers of synovial membrane to quite a dense and firm band with considerable fat. The thickness at the base is usually about one-eighth to one-quarter of an inch. The flat sides are superior and inferior, the position in the joint being nearly horizontal (Fig. 1). The alar ligaments are two similar folds of synovial membrane extending from either end of the mucous ligament outward and then upward, skirting the margin of the patella, lying between the anterior edge of the articular portion of the condyle and extending to about the middle of the patella. These two folds, just as the mucous ligament, may consist solely of synovial membrane, or they may contain fat

and appear then irregular and lobulated. They are not symmetrical, as a rule, one side being more pronounced than the other. Their relation to the margin of the anterior articular surfaces of both condyles and to the patella exposes them to injury in any accident affecting the anterior part of the joint; and, inasmuch as their position in the joint corresponds to the two little triangular fossæ found on palpation of the joint at either side of the ligamentum patellæ and extending up along the patella, it will readily be seen how the conditions such as described in the following cases did arise (Fig. 2). Besides these two structures there exists in some knees a transverse fringe along the line of the joint. This fold of synovial membrane corresponds in structure to the synovial folds already described and contains a varying amount of fat (Fig. 3).

CASE I.—M. S., aged fifteen years; male; August 18, 1903. Seven months before entrance to the Lincoln Hospital "sprained" right knee. The knee swelled occasionally after exertion. While swollen, he has been obliged to "sit about" for a few days because of pain and a sense of weakness. The swelling never goes away entirely, though there is no discomfort in the intervals between the painful attacks. The history is otherwise negative. Comes to hospital towards end of attack. Physical examination is negative except for the right knee.

Right Knee.—Considerable fluid; patella floats; normal fossæ obliterated; subcrural bursa prominent. Right knee over middle of patella one and one-half inches larger than left. Slight limitation of motion. Fluid in joint not under much tension. Slight tenderness in region of patellar ligament and along inner side of joint line. Active and passive motion not painful. Slight lateral motion, more than on left side. No inflammatory sign. Limps.

Operation.—Curved incision from ligamentum patellæ sidewise over joint line four inches. Fluid in joint light brown. Alar ligament injected; swollen; under patellar ligament a free jagged fringe projection into joint. Semilunar cartilage, coronary ligament, and anterior crucial normal.

Diagnosis.—Old rupture of ligamentum mucosum, contusions of alar ligament and transverse synovial fringe.

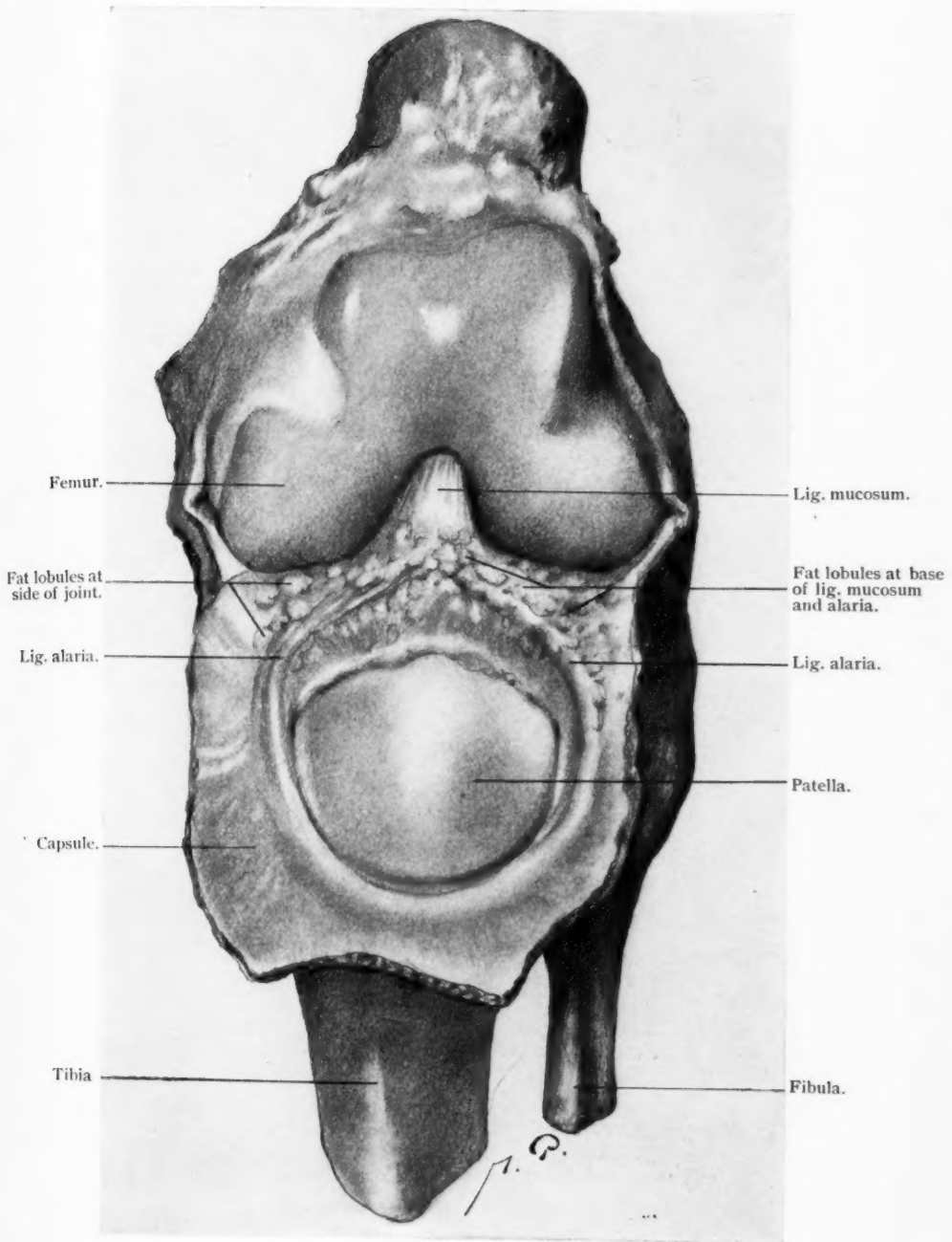

FIG. 1.—Normal joint. Patella turned down.

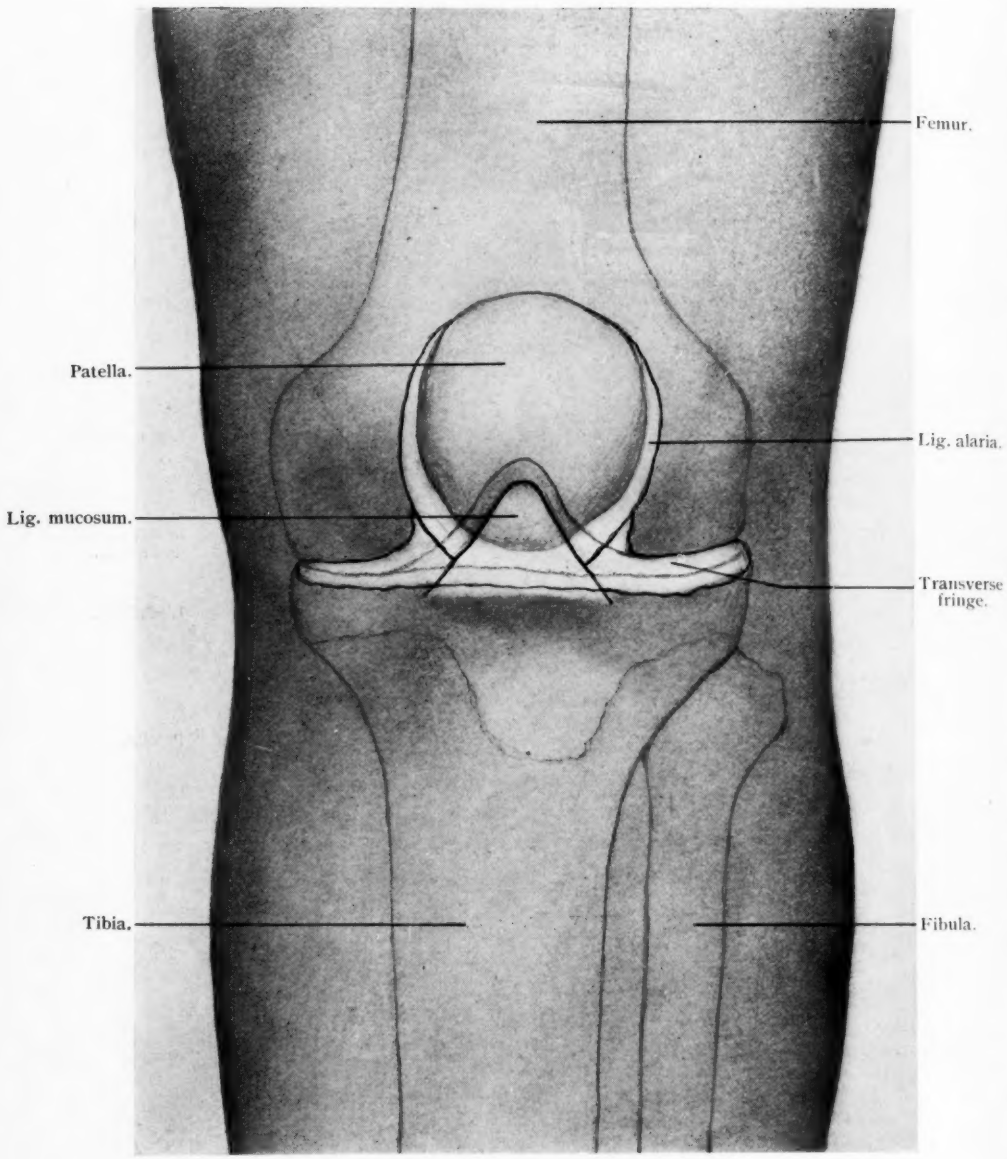

FIG. 2.—Diagram of position of synovial ligaments.

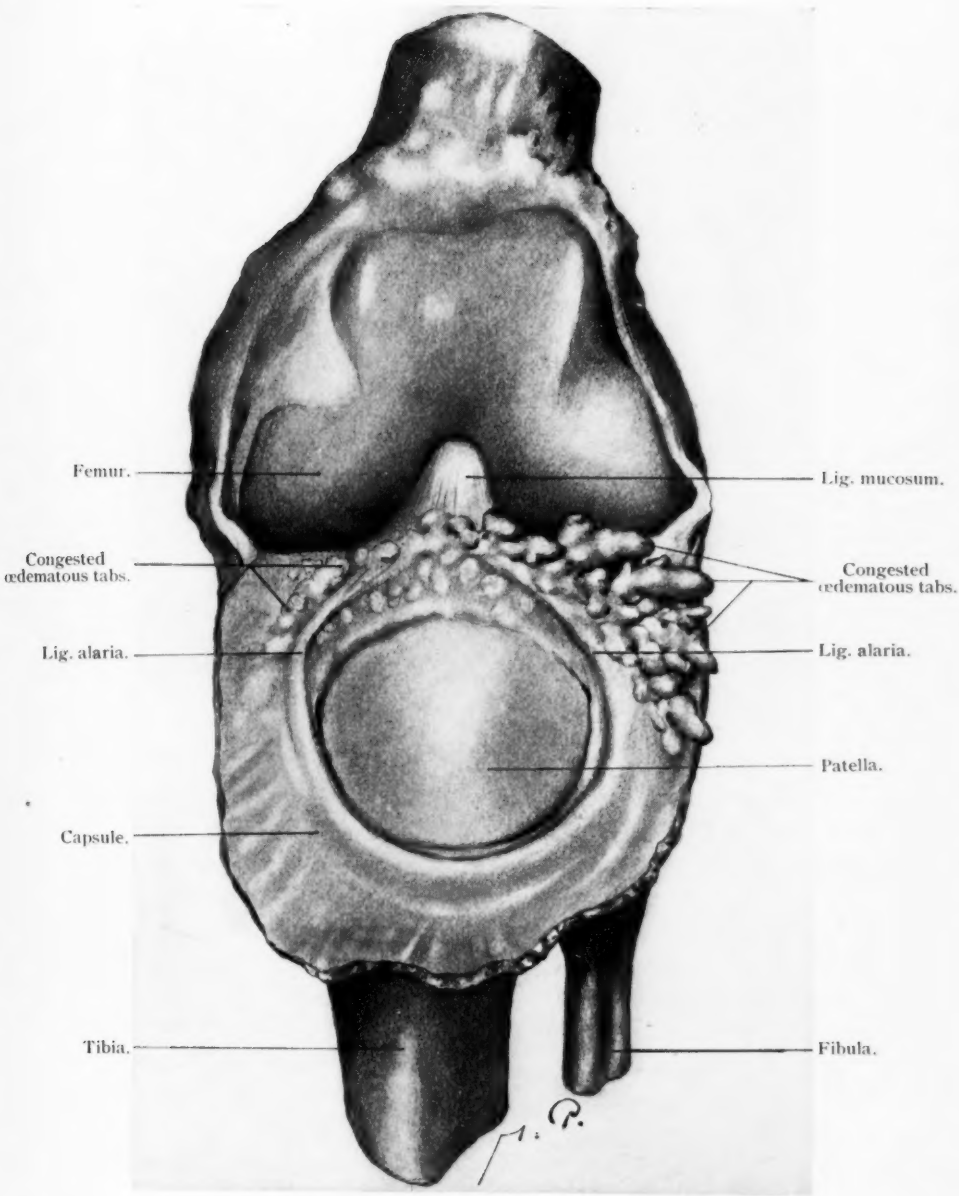

FIG. 3.—Semidiagram of appearance of chronically irritated infiltrated fat folds and joint hinges.

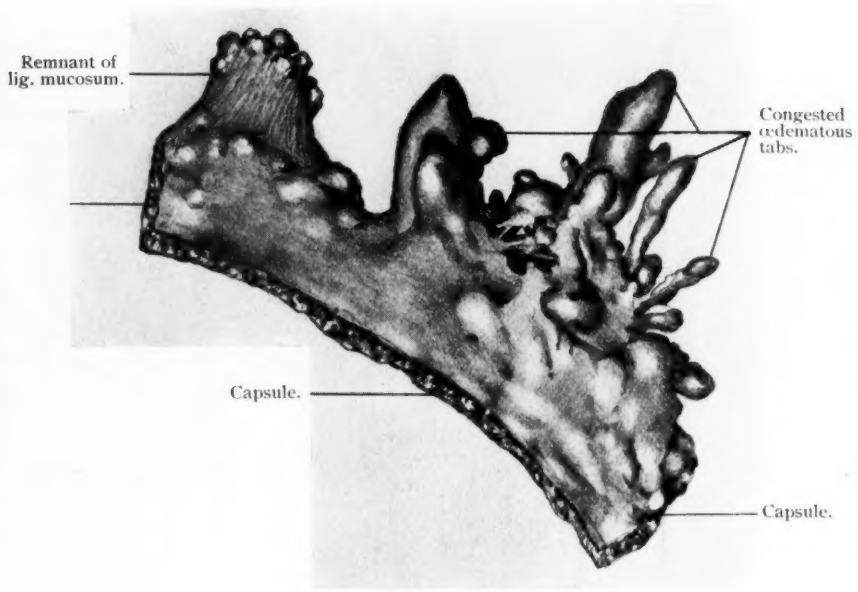

FIG. 4.—Specimen from Case IV.

Ligamentum mucosum and inner alar ligament excised with piece of capsule. Joint washed. Capsule closed with continuous fine catgut. Fascia with continuous chromic gut. Skin, continuous silk. Small rubber tissue-skin drain. Dry dressing; plaster of Paris.

Temperature before operation, 98° to 99° F. Day after operation, 102.4° F.; next day, 100.5° F., then normal.

Four days after operation wound examined. Some fluid in joint. Aspirated, fluid pale pink; pressure dressing. Did not fill up again. Primary healing. Walked on twenty-first day. Discharged on twenty-ninth. Examined nine months after operation.

Right knee one-half inch larger than left; no excess of fluid. Patella does not float; no point of tenderness. Has had no recurrence of old "swelling." No limitation of motion. No bulging of scar region. No limp.

Pathological report of excised tissue: "Chronic inflammatory." (Fig. 4.)

CASE II.—J. J., aged thirty-three years; male; October 5, 1903. Six weeks before entrance fell from bicycle. Knee swelled one-quarter of an hour after injury. Stayed in bed two weeks; knee then reduced to normal size. Since then has been about his work, but at times has a sharp "catch" on outer side of knee, following which there is some local tenderness for a few days. Has not noticed any swelling. Has not stopped work until yesterday, because of an attack more severe than the average. Physical examination negative except for one point of tenderness to outer side of patellar tendon, slight swelling here. No fluid in joint made out. On flexing and extending knee with thumbs at either side of patellar tendon something is felt to slide beneath the thumb over the outer side. Slight limitation of flexion and extension. No inflammatory signs. The sliding object was erroneously considered to be a loose meniscus.

Operation.—Curved incision from ligamentum patellæ outward. No excess of fluid in joint. Semilunar cartilage normal, also coronary ligaments. From beneath ligamentum patellæ outward is an irregular fringe, in places one-half inch broad by one and one-half inches long, with irregular nodular tabs; slightly injected; slips backward and forward on flexing and extending the leg. This represents the mass mistaken for a loose cartilage.

Fringe excised with a piece of capsule. Capsule closed with fine continuous catgut; fascia with continuous chromic gut; skin with silk. Plaster of Paris. Temperature after operation, 101.2° F. on first day, 102.4° F. on second, then in course of three days to normal. Per primary union. Fluid did not accumulate in joint. Walked on fourteenth day, discharged on twentieth.

Diagnosis.—Contusion and laceration of alar ligament and synovial fringe.

Pathological Examination.—Tuberculosis.

An effort to locate the patient six months later failed.

Case III.—J. A., aged twenty-seven years; male; January 16, 1904. Five and one-half weeks ago fell while catching horse. Right knee swelled immediately; walked home. In bed two days, then to hospital. Treated with plaster of Paris three weeks and then splinted. Swelling has remained the same since first treated.

On examination, knee distended, tense. Contour sharply outlined. Normal depressions felt, patella floats. Flexion 15 degrees less than on left side. Extension 10 degrees less than on uninjured side. Circumference one and three-quarters inches greater over middle of patella. No inflammatory sign or symptoms. Walks lame. Tenderness along line of joint at both sides of ligamentum patellæ, more so on inner side.

Operation.—Vertical incision along inner side of patella. Joint contains thick, syrupy, dark-brown fluid. Semilunar cartilage, coronary and anterior crucial ligaments normal. The synovial fringes along anterior aspect of joint, alar, and mucous ligaments are thickened and project into joint. The adjoining synovia is also injected. Fringes removed, joint closed after washing. Per primary healing. Allowed to walk on tenth day. Return of swelling; bed; splint; aspirated; fluid pale. On twenty-first day no swelling left; twenty-eighth day walks and discharged from hospital. Seen two weeks later, no fluid in joint, but favors this leg, and walks with slight limp, although no pain, and can attend to duties.

Pathological Examination.—" Chronic inflammatory."

Diagnosis.—Contusion of alar ligament with secondary changes.

Seen again at the end of thirteen months. The limp had gone, but still avoided complete extension of leg. No subjective signs.

CASE IV.—A. P., aged forty-seven years; female; September 6, 1904. Two months ago fell from chair and wrenched knee. Knee swelled at the time for about two weeks. Painful area along outer side of joint. No limit of motion. Swelling went except for a small area corresponding to the painful region. The knee had been strapped, but no improvement. When sitting, there is no pain, but after keeping quiet for some time knee seems stiff and painful when attempting to walk. Walking and going up and down stairs most painful. Sensation of something slipping beneath finger in swollen region.

Operation.—Incision outer side of joint through the swollen area. Very little clear fluid in joint. Synovia under swollen regions injected, and also alar ligament over an area of about one-half by three-quarters of an inch reddened and much larger than in adjoining region. Mucous ligament is free in joint with thickened jagged margin. On flexing and extending leg, this reddened area comes to be between outer margin of patella and condyle of femur, and corresponds to the mass felt to slip beneath the finger before operation.

Diagnosis.—Laceration of mucous ligament, contusion of alar folds. Joint closed; bed for three weeks; per primam healing. No accumulation of fluid after operation. Temperature, 101° F. on first day, then normal. Walked on twenty-second day.

Seen four months after operation. Has had no return of discomfort; no fluid in joint. Joint crepitus is still more than on opposite side, and there is very slight limitation of extension; no subjective signs.

Of the knees that happen to come under the author's care, these were chosen for operation because there was a recent history of injury combined with subsequent conservative care without beneficial result.

It is a common thing to see abnormal knees with and without effusion. A diagnosis of the nature of the trouble is often impossible. The condition is termed chronic synovitis or is explained as being due to rheumatism, rheumatoid arthritis, or is called simply "chronic knee." The exact etiology cannot be determined. In a certain number of these cases there is a distinct history of trauma, with a subsequent history of con-

tinuous or intermittent discomfort which progressed slowly with years.

It is this group with an early history of trauma which led me to select the class of cases above referred to for interference, in the hope that, by an early operation after short and unsuccessful treatment, some lesion might be found which would account for the lack of response to such care, and for the subsequent impairment of function. By removing this source of trouble, one might prevent the progress of a process which would finally become chronic, and thereby limit the number of knees which later are so evidently beyond the sphere of surgical interference.

It is not usual to operate upon traumatic knees in the early stages unless there is the possibility of making a fairly accurate diagnosis. One feels justified in entering the abdominal cavity for exploratory purposes on very slight provocation because of the improvement in our operative technique, and because we are supported by the knowledge that the peritoneum is well able to take care of a wide margin of error on our part.

It is not so with the knee-joint, although the knee will defend itself to a moderate extent, as shown by the cases of mild infection which recover after no other interference than aspiration. Still, its powers of recuperation cannot be compared with those of the peritoneum, and the disastrous result of an infected knee is painfully impressed upon the mind of all except the most fortunate surgeons. There is another reason, also, why we do not care to risk operating on the knee for exploratory purposes. An individual with an infected peritoneum does one of two things,—he either gets well and does not show much evidence of what he has been through, or he dies. The man with an infected knee does the same,—he recovers or he dies. The calamity of the fatal cases is equally great, but the recoveries differ; the man recovering from an infected knee is apt to have a stiff joint or have had an amputation,—memoranda at all times connected in the individual's mind, throughout his life, with the unfortunate surgeon's name and skill.

For these reasons, no man who is not trained daily in surgical procedures and who does not make every effort to keep his technique as perfect as possible, is justified in opening the knee-joint. Granted these essentials, we may interfere in cases where the diagnosis is less certain, in the hope that the benefit will be sufficiently great to offset the risk.

The four cases above referred to—operated upon for exploratory reasons—were selected cases. An absolute diagnosis was not possible, but it was highly probable that some lesion would be found,—a supposition justified as subsequent conditions proved. The number is too small to draw conclusions from except for individual cases.

All four cases had two apparent subjective symptoms,—pain and limitation of function. In all four these two symptoms were relieved for the time. It is not possible to say what the permanent result will be, but in two of the cases one and one-half years and one year have passed without return of the symptoms.

Of the objective signs, there was a varying degree of effusion in all four cases, limitation of motion in three, and some increase of joint crepitus in one. The effusion disappeared in all; the limitation of motion was entirely overcome in one; in one it persisted, and one could not be subjected to a late examination. The case with joint crepitus still had joint crepitus after six months, but not as marked. In all four cases there were before operation symptoms which intermittently or continually interfered with the individual's daily duties. In the three cases which could be examined at a later date there had been no recurrence of these symptoms. One patient still had a slight limp, which was not painful. Passive motion was perfect. No reasonable explanation was found.

Although the subjective signs which interfered with the duties of life were relieved, two of the three seen at a later date complained " that at times they did not feel quite as strong as the other side."

It is therefore evident that in the above four cases the greatest improvement was in the subjective signs, and that

certain objective symptoms remained, which, however, did not interfere with the function of the member.

It will be noted that in Case II the pathological report showed tuberculosis. The process was fresh, well marked, and active. Macroscopically, the writer could see no great difference in the appearance of the various synovial fringes excised, with the exception that in the specimen from Case II the entire region was much more vascular, whereas in the other three the fringes appeared pale, œdematous, with hæmorrhagic areas evidently the seat of recent insult. Whether in Case II a pre-existing tuberculous condition was injured, or whether an injured synovial fringe had become tuberculous, is a matter that could not be decided because of the absence of facts justifying an opinion one way or the other. There was no evidence of bone disease; but, considering the etiological importance of trauma in tuberculosis, combined with the fact that synovial membranes elsewhere in the body may be the seat of primary tuberculosis, and that it is not uncommon to find on operation extensive villous tuberculosis of the entire knee-joint synovia without any sign of bone disease, it would seem hard to conclude that a bruised knee-joint fringe might not occasionally be the locus minoris resistentiæ for tuberculosis.

It is my opinion that every traumatic knee showing localized tenderness with effusion into the knee-joint should be aspirated, provided there is not a marked diminution in the amount of effusion under treatment at the end of one week. Should the condition be a hæmarthrosis, it is better to make a small incision and wash the joint clean. The thick fluid and possibly clots do not run out well through a trocar. Fluid, if allowed to stay in the joint too long, does harm in two directions. First, the capsule and ligaments become chronically distended and lax, interfering with the stability of the joint and paving the way to permanent alteration of the joint structures. Secondly, the contained fibrin, according to König, becomes deposited on the wall of the joint, or floats free in the joint, covers with epithelium, and so gives rise to foreign bodies in the joint. Should fluid reaccumulate after aspiration,

it must be drawn off again. After a hæmarthrosis has been emptied by open incision, the joint will at times fill again. This second fluid can generally be removed by aspiration, not being as thick as the first.

As far as the injured synovial ligaments are concerned, if repair should always take place without leaving subjective or objective symptoms, there would be no reason to connect the injury with the etiology of " chronic knees," and therefore no reason for interference.

Such is unfortunately not the case. Not only do case histories like the above four illustrate that compltee restitutio ad integrum does not always occur, but joints opened after much greater lapse of time since an injury, for some reason or other, show conditions of the synovial ligaments that could readily be explained as being of traumatic origin primarily. The crushed, torn, and infiltrated alar and mucous ligaments act as foreign bodies in the joint, are perpetually being injured, giving rise to pain and repeated attacks of effusion with the secondary results. The joint is chronically irritated by mechanical interference, and gradually undergoes such secondary changes as give rise to chronic effusion, relaxed ligaments, increased lateral motion, intermittent pain, changes in cartilage, synovial membrane, etc. At times these injured ends of the synovial membranes become completely separated, and are therefore one of the causes of foreign bodies. They may also be found firm, almost cartilaginous, a change possibly due to trauma primarily. Cases where the offending piece of tissue has clinically all the signs and symptoms of a free floating body; and yet still connected by one or more bands with the original seat, are not uncommon. It is for these reasons that we conclude that if, on walking about, fluid reaccumulates and tenderness and pain reappear at intervals after four or six weeks of conservative treatment, the patient should have the conditions connected with an operation explained to him, for it would seem, judging from the cases above cited, that an early operation for such bruised and lacerated synovial ligaments of the knee-joint will give the patient in some cases

complete subjective relief, combined with a varying degree of objective improvement, besides diminishing in all probability his chances of becoming at some future date a victim of a so-called " chronic joint."

As Case II shows, it may occasionally happen that one stumbles upon a very early tuberculous lesion, the removal of which representing an advantage hardly necessary to emphasize.

Far be it, very far be it, from my intention to recommend promiscuous exploration of the knee. For reasons apparent to every surgeon, it might not be unjust to conclude that any diminution of fear of opening the joint would be followed by a corresponding increase in the number of calamities.

It is, however, the writer's opinion that there are many knees not operated at the present time which should be opened because of the benefit to be derived. One class of such knees is composed of traumatic cases that, after judicious and properly applied conservative care, still show signs representing conditions which, if allowed to persist, will surely lead to secondary changes and symptoms such as we are perpetually finding in patients afflicted with the so-called " chronic knee." For example, should there be, after injury to a knee, local pain, effusion into the joint, local swelling, with or without other subjective and objective signs, and should, in spite of rational conservative care, these symptoms persist or reappear after cessation of treatment, then the knee should be opened while the seat of trouble can be recognized and before serious secondary changes have occurred.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY.

Stated Meeting, April 12, 1905.

The President, HOWARD LILIENTHAL, M.D., in the Chair.

ENORMOUS SARCOMA OF BREAST.

DR. HOWARD LILIENTHAL presented a woman, aged twenty-nine years, who was admitted to Mt. Sinai Hospital on February 24, 1905. About six years before her admission she first noticed a small, painless mass, about the size of a marble, in the right breast. This mass rapidly grew in size, especially during the year prior to her admission. There had been no loss of flesh or strength.

On admission, a mass was found involving the whole right breast. It was about the size of an adult head. Its surface was nodular because of the presence of projecting lobules, some of which felt soft, others hard. The tissue between the lobules felt cystic in some places, firm in others. The tumor was adherent to the overlying skin, which was of a bluish-red color, and contained many dilated veins. The whole mass was attached to the breast by a flat pedicle, six inches wide and three-quarters of an inch in thickness. A few small, soft glands were felt in the right axilla. The left breast was normal.

On March 1, 1905, a radical amputation of the breast was done, the pectoral muscles being removed and the right axilla cleaned out. The mass at the time of its removal weighed seven and one-half pounds. The operation was attended by an unusual amount of hæmorrhage, which might be expected in the removal of a growth of such dimensions. The pathologist,

Dr. F. S. Mandlebaum, pronounced it a myxosarcoma, with cystic degeneration. The patient made an uninterrupted convalescence, and was discharged eighteen days after the operation.

URETERAL CALCULUS; TWO CASES.

Dr. John F. Erdmann presented a man, twenty-nine years old, who first came under his observation on the first day of March, 1905. He gave a history of having had a pain in the right side for three or four years. The pain was paroxysmal in character, and at times uncontrollable. His last attack had occurred about five weeks before, and had necessitated his going to bed for twenty-four hours. At no time had he been bedridden for a longer period than this. Vomiting sometimes occurred during the attacks, and he also stated that they had been accompanied by jaundice of the face. He complained of pain in the region of the right kidney and extending down towards the bladder. At the time of voiding urine he would have a peculiar pain in the bladder, but there were no symptoms pointing to the genital organs. He was constipated, and also complained of pain in the region of the appendix.

Examination of the abdomen did not give any pronounced evidences upon palpation. In fact, there was no sensitive spot on pressure anywhere over the body. A tentative diagnosis of ureteral stone was made. The patient was X-rayed by Dr. Caldwell, and the plate showed a large shadow midway between the spine of the ischium and the sacro-iliac synchondrosis, in the region of the right ureter. The shadow was seven-eighths of an inch long, seven-sixteenths of an inch wide at its widest point, and shaped like an olive pit.

Operation, March 11, 1905. An incision was made beginning at the inner portion of the right rectus muscle, and extending outward with a very slight curve to and above the anterior superior spine of the ilium. The peritoneum was accidentally punctured, and feeling that no harm could be done by making a transperitoneal examination, and that thereby the operation could be more rapidly terminated, the opening in the peritoneum was enlarged. Through this opening the stone was readily palpated. Before dissecting back the peritoneum for a retroperitoneal operation, the appendix, which was found to be adherent and sclerosed, and showed evidence of earlier disease, was re-

moved. The peritoneum was then dissected up and the ureter exposed. By keeping two fingers within the peritoneal cavity, Dr. Erdmann said he was able to hold the stone in such a position that incision of the ureter retroperitoneally was readily accomplished. The stone was extruded through a longitudinal incision which was closed with silk sutures, the peritoneal wound was closed, and a cigarette drain was placed behind the peritoneum down to the site of the ureteral wound. The abdominal wound was closed, with the exception of the site of the retroperitoneal drain. The patient made a perfect recovery, and left the hospital on the fourteenth day. The urine, which was bloody on the first and second days, cleared up on the third. The patient had not complained of any of his former urinary difficulty since the operation.

Dr. Erdmann presented, also, a man, twenty-three years old, who stated that six months ago he had a pain in his abdomen extending well into the back. He had had several attacks of pain resembling that of appendicitis, necessitating his remaining in bed for anywhere from one to four days at a time. Three days ago he had an attack which was ushered in by vomiting and pain in the abdomen. He also complained of pain in the right side of his back. This last attack had kept him in bed for two days. He had suffered continuous pain from twelve at night to early morning of the following day. He also had attacks of pain that would manifest themselves in the glans penis, but not in the testes.

Upon examination, the abdomen was found to be extremely sensitive in the high appendicular region, and there was also pain by bimanual examination over the right kidney. The patient was X-rayed twice, four plates being taken. In one of these, a small shadow located at a point opposite the ischial spine in the pelvis was taken for a stone in the ureter, but the physical signs and the urine analysis tended to negative that diagnosis. An incision similar to that employed in the preceding case was made. The skin was retracted in the course of the rectus, and the anterior layer of the sheath of the rectus was cut in the line of the skin incision, so that a separation of the muscle fibres of the abdominal wall could be produced. The peritoneum and deep fascia were cut in the axis of the rectus. Exploration revealed a hard nodule, like a gland, within an inch of the bladder wall.

The appendix was congested and bound by numerous adhesions. The pelvic peritoneum was loosened from the deeper structures and the ureter exposed. It was then seen that the small, hard body was a calculus of the ureter, within an inch of its bladder orifice. The ureter was incised in its long axis and the stone extruded. The ureteral opening was then closed with silk, the peritoneum dropped back, the appendix removed, and the peritoneal wound closed after the kidney had been palpated, with negative results. A drain was then put down to the incision in the ureter, and the external wound completely closed, with the exception of the point of the drain. The operation occupied about forty minutes. The stone was seven-sixteenths of an inch long, five-sixteenths of an inch at its widest point, and three-sixteenths of an inch thick. It was of an irregular mulberry shape.

TETANUS FOLLOWING INTERVAL OPERATION FOR APPENDICITIS, WITH ASEPTIC HEALING OF WOUND.

DR. WILLY MEYER presented a man, twenty-seven years old, who was admitted to the German Hospital on January 21, 1905. Seven weeks before he had an attack of appendicitis, characterized by chills, fever, and pain in the right side of the abdomen.

A week ago he again had an attack of pain in the region of McBurney's point, accompanied by chills and fever. There was no vomiting. Since the onset of the attack his pain had grown worse, and he also complained of severe frontal headache. His appetite was poor; the bowels constipated.

Examination showed a well-developed man, whose general condition was good. There was no dyspnœa nor jaundice. There were a few herpes on the upper lip. Lungs and heart negative. The abdomen was not distended. There was slight tenderness in the right iliac region, and pressure over McBurney's point elicited some pain. No mass could be felt. The liver and spleen were not palpable. A rectal examination was negative. The patient's temperature on admission was 105.4° F.; pulse, 128; respirations, 28.

Operation, February 2, 1905. The appendix was removed by the rectus incision. It was covered by adhesions, and somewhat injected. The stump of the appendix was inverted by purse-string suture covered with three Lembert sutures. The abdomen

was closed in layers. The wound healed by primary union, and the silkworm-skin sutures were removed on February 9.

On February 12 the patient complained of some inability to open his mouth, and on the following day he had a marked spasm of the masseter muscles on both sides. The teeth could only be slightly opened, and the patient complained of pain on both sides of the jaw. A 3 per cent. carbolic acid solution was injected every two hours. On February 14 the trismus was more marked. There was slight rigidity of the neck muscles and pain in the back of the neck. The eyebrows were elevated, due to contraction of the orbicularis. Risus sardonicus was noticeable. The abdomen was rigid. On this day, intraspinal injections of antitoxin serum were begun by Dr. Meyer. On the following day the patient was able to open his mouth about 3 centimetres. The abdomen was still rigid. There was marked spasm of the muscles and some pain on pressure over the abdominal scar. Three days later the patient had a clonic spasm lasting three minutes. On the following morning he had two similar convulsions, lasting three and four minutes respectively. Assumed an opisthotonos position. Trismus was marked. There was great pain in the neck and considerable dysphagia. He could not retain nourishment per os, and rectal feeding was begun.

On February 21 the patient's condition was improved. The spasm of the neck muscles and the opisthotonos had entirely disappeared, but he still complained of a little pain in the neck. Trismus was not so intense. He took plenty of nourishment per os. He continued to improve, and on March 11 he was able to open his mouth so that three fingers could be admitted. There was still some spasm of the masseter muscles, but the abdominal rigidity was less marked. On March 15 he stated that he felt perfectly well. Trismus and the rigidity of the abdominal muscles had disappeared, and he had no more pain.

During the course of his illness, the patient had received four intraspinal antitoxin injections between February 14 and 17, the dose ranging from 5 to 15 cubic centimetres. Between February 15 and 21 he also received seven subcutaneous antitoxin injections, of 10 cubic centimetres each. Between February 14 and March 16 he was also given hypodermic injections of a 3 per cent. solution of carbolic acid, a syringeful every two hours. He

also received per rectum, from February 14 to 17, 3.0 of chloral hydrate in solution every four hours.

On February 19 blood cultures made from a small amount of serum collected below the sutured skin of the appendectomy wound gave a negative result.

Dr. Meyer said he had looked up the literature on this subject. In one of the most recent articles by Lanz and Javel there is a report of a pathological examination of 8 normal appendices and 138 diseased ones. In every instance in which the normal appendix was examined, quite a number of species of bacilli were found, especially the colon bacillus, then the bacillus of malignant œdema, and the pseudotetanus bacillus. In 10 per cent. of the 138 inflamed appendices, the result of the pathological examination was negative, showing sterility of organ, probably due to the work of the leucocytes. Dr. Meyer said the only explanation he could offer for the development of the tetanus in this case was that either the true or pseudotetanus bacillus was present in the appendix, and handling the organ caused the absorption of the micro-organism from the intestinal tract.

CARCINOMA OF THE MALE BREAST.

Dr. Willy Meyer presented a man, forty-six years old, who had been operated on in July, 1903, for carcinoma of the left breast. The radical operation was done as devised by Dr. Meyer ten years ago. The skin incision, as employed during the last seven years, commenced at the insertion of the pectoralis major tendon, passed about one inch and a half above its axillary border, and swept around the breast, forming two large flaps, an upper and a lower, ending beyond the middle of the sternum. By his method, one worked towards the sternum instead of away from it, and the entire pectoralis major was removed. By cutting the tendon of that muscle at the outset, one had, of course, to remove the entire belly of the pectoralis major, and gained immediate access to the main vessels feeding the breast. Immediate skin grafting was always resorted to.

Up to the present time, this patient showed no signs of a recurrence, and the functional result, so far as motion in the arm was concerned, was perfect. There was some œdema of the forearm.

Dr. Lilienthal said the method of operation described by

Dr. Meyer had also been followed in the case of enormous sarcoma of the breast that he had shown, and excellent motion of the arm had resulted.

STRANGULATED UMBILICAL HERNIA.

Dr. Joseph A. Blake said that during the past winter he had operated on four cases of strangulated umbilical hernia, and one case of strangulated relapsed umbilical hernia, all occurring in his service at the Roosevelt Hospital, a remarkable number for so short a period, considering the rarity of the condition.

One patient, a woman fifty-one years of age, was in such an advanced stage of chronic nephritis, emphysema, and mitral disease, that she could not lie down, and was operated upon in a half-reclining position under Schleich infiltration anæsthesia.

Owing probably to the diminished vitality of her tissues, suppuration occurred about the chromicized gut sutures in the depth of the wound, and extended to the peritoneum, causing her death on the tenth day after operation. The remaining cases, which recovered, were as follows:

Case I.—L. M., a woman forty-one years of age, was admitted on November 21, 1904. She had been operated upon three years previously for an umbilical hernia. A relapse had been noted for a year and a half. Six days before admission, symptoms of strangulation had appeared, and continued without remission up to admission.

The patient's weight was estimated to be between 250 and 300 pounds. Examination revealed a very large protrusion in the region of the umbilicus, measuring nine inches in a vertical by fourteen inches in a horizontal direction. The mass was tense and sensitive; the skin was reddened in places, and distinct gaseous crepitation was evident; fever was present; the pulse was 116 and rather feeble.

Under nitrous oxide and ether anæsthesia, a transverse elliptical incision, six by fifteen inches, was made, and the sac opened. The contents consisted of the transverse colon and great omentum, and running in and out, in an indescribable manner, through the latter and between bands of scar tissue which in places was half an inch thick, was a loop of small intestine, distended and necrotic in several places. The mere freeing of this loop took nearly an hour.

also received per rectum, from February 14 to 17, 3.0 of chloral hydrate in solution every four hours.

On February 19 blood cultures made from a small amount of serum collected below the sutured skin of the appendectomy wound gave a negative result.

Dr. Meyer said he had looked up the literature on this subject. In one of the most recent articles by Lanz and Javel there is a report of a pathological examination of 8 normal appendices and 138 diseased ones. In every instance in which the normal appendix was examined, quite a number of species of bacilli were found, especially the colon bacillus, then the bacillus of malignant œdema, and the pseudotetanus bacillus. In 10 per cent. of the 138 inflamed appendices, the result of the pathological examination was negative, showing sterility of organ, probably due to the work of the leucocytes. Dr. Meyer said the only explanation he could offer for the development of the tetanus in this case was that either the true or pseudotetanus bacillus was present in the appendix, and handling the organ caused the absorption of the micro-organism from the intestinal tract.

CARCINOMA OF THE MALE BREAST.

Dr. Willy Meyer presented a man, forty-six years old, who had been operated on in July, 1903, for carcinoma of the left breast. The radical operation was done as devised by Dr. Meyer ten years ago. The skin incision, as employed during the last seven years, commenced at the insertion of the pectoralis major tendon, passed about one inch and a half above its axillary border, and swept around the breast, forming two large flaps, an upper and a lower, ending beyond the middle of the sternum. By his method, one worked towards the sternum instead of away from it, and the entire pectoralis major was removed. By cutting the tendon of that muscle at the outset, one had, of course, to remove the entire belly of the pectoralis major, and gained immediate access to the main vessels feeding the breast. Immediate skin grafting was always resorted to.

Up to the present time, this patient showed no signs of a recurrence, and the functional result, so far as motion in the arm was concerned, was perfect. There was some œdema of the forearm.

Dr. Lilienthal said the method of operation described by

Dr. Meyer had also been followed in the case of enormous sarcoma of the breast that he had shown, and excellent motion of the arm had resulted.

STRANGULATED UMBILICAL HERNIA.

Dr. Joseph A. Blake said that during the past winter he had operated on four cases of strangulated umbilical hernia, and one case of strangulated relapsed umbilical hernia, all occurring in his service at the Roosevelt Hospital, a remarkable number for so short a period, considering the rarity of the condition.

One patient, a woman fifty-one years of age, was in such an advanced stage of chronic nephritis, emphysema, and mitral disease, that she could not lie down, and was operated upon in a half-reclining position under Schleich infiltration anæsthesia.

Owing probably to the diminished vitality of her tissues, suppuration occurred about the chromicized gut sutures in the depth of the wound, and extended to the peritoneum, causing her death on the tenth day after operation. The remaining cases, which recovered, were as follows:

Case I.—L. M., a woman forty-one years of age, was admitted on November 21, 1904. She had been operated upon three years previously for an umbilical hernia. A relapse had been noted for a year and a half. Six days before admission, symptoms of strangulation had appeared, and continued without remission up to admission.

The patient's weight was estimated to be between 250 and 300 pounds. Examination revealed a very large protrusion in the region of the umbilicus, measuring nine inches in a vertical by fourteen inches in a horizontal direction. The mass was tense and sensitive; the skin was reddened in places, and distinct gaseous crepitation was evident; fever was present; the pulse was 116 and rather feeble.

Under nitrous oxide and ether anæsthesia, a transverse elliptical incision, six by fifteen inches, was made, and the sac opened. The contents consisted of the transverse colon and great omentum, and running in and out, in an indescribable manner, through the latter and between bands of scar tissue which in places was half an inch thick, was a loop of small intestine, distended and necrotic in several places. The mere freeing of this loop took nearly an hour.

Sixteen inches or more of this loop were resected and the ends joined by suture. The major part of the omentum was removed with the sac, the remainder being used to help close the aperture, a radical operation being impossible.

The patient developed severe asthma after the operation, so that for four days she had to sit up in order to breathe, and her condition was very precarious. This subsided under antispasmodics and cupping, and she eventually made a good recovery, being discharged cured on the forty-fourth day.

Case II.—K. R., a woman of fifty-five years, was admitted on the same night as the previous patient. She had had a small reducible umbilical hernia for five years.

Three days before admission, she had had an attack of severe pain in the hernia, which became irreducible. The bowels had acted on the following day, after taking castor oil, and again on the next day, spontaneously. She had not vomited.

Operation was delayed for thirty-six hours on account of the absence of signs of obstruction and was then performed on account of the increasing signs of inflammation of the hernia. A probable diagnosis of a partial enterocele (Richter's hernia) was made. Operation revealed this to be the case, less than half the circumference of the bowel having been caught and strangulated, resulting in necrosis of an area of about the size of a quarter of a dollar. There was no omentum in the sac. The necrotic area was infolded by a few Lembert stitches, and the gut was dropped back into the peritoneal cavity. The abdominal wall was repaired by lapping from above downward, according to Mayo's method. Recovery was uneventful.

Case III.—B. McL., a woman fifty-seven years of age, was admitted on February 15, 1905. She had had an irreducible umbilical hernia for fifteen years, which had gradually increased in size to that of a child's head. There had been repeated attacks of obstruction, which had been relieved by cathartics.

For three days before admission there had been symptoms of strangulation, persistent vomiting, complete obstipation, distention, and rapid increase in the size of the tumor to that of a foot-ball.

On admission she was markedly prostrated; the heart's action was rapid and feeble; there were sonorous and sibilant râles over both lungs. The hernia was tense, tender, and irre-

ducible; the skin was reddened; tympany was present, and gurgling was elicited.

Under nitrous oxide and ether anæsthesia, a transverse elliptical incision was made, and the sac opened. The contents consisted of omentum and small intestine.

The latter was devitalized in many places from pressure from the bands and septa in the sac. It was also widely adherent. After it was freed its condition was so questionable, that, although it was not distinctly gangrenous, it was decided to excise the entire loop. This was done, forty-eight inches being removed, and the ends were united by suture.

Radical cure by the vertical lapping method was done. The patient made a good recovery.

CASE IV.—B. M., a woman fifty-one years of age, was admitted on March 15, 1905. During the six months preceding her admission, she had had several attacks of pain situated in the umbilical region, which were accompanied by vomiting. No hernia had been discovered. The attacks had all been transitory.

Four days before admission she had a similar attack, excepting that the vomiting persisted, and obstipation was complete. Examination revealed a very small umbilical hernia, almost hidden in the fat of the abdominal parietes. It was tender and the skin was somewhat discolored.

Under nitrous oxide and ether anæsthesia, a transverse elliptical incision was made; the small sac was opened, and a short loop of gut was found, strangulated but viable. It was reduced. The sac did not contain any omentum.

A radical cure by the Mayo method of vertical lapping was performed. Recovery was uneventful.

In summing up, Dr. Blake said that he preferred the operation of vertical lapping in cases where time was a factor, and in cases in which the diastasis of the recti was not marked. When diastasis was marked and the abdominal walls were loose and flaccid, he preferred transverse lapping. In all cases of intestinal resection, particularly in asthmatic patients, he preferred suture to union by mechanical aids.

DR. LILIENTHAL said that in one of Dr. Blake's cases, the second one he had reported, an area of necrosis about the size of a silver quarter was infolded by a few Lembert's stitches and the gut was dropped back into the peritoneal cavity. The speaker

asked Dr. Blake whether he considered this a safe procedure? In most of those cases where there was a suspicious gangrenous area, the process was likely to have extended beyond the actual limits of the lesion, and he thought a liberal resection would be the safer method.

Dr. Blake, in reply to Dr. Lilienthal, said that in the case referred to, the small necrotic area was on the opposite side of the mesentery, and the strangulation only involving that side of the gut, the circulation in the rest of the gut was unimpaired.

RUPTURE OF THE SMALL INTESTINE.

Dr. Joseph A. Blake presented a man, thirty-eight years of age, upon whose back a heavy bureau had fallen, knocking him to the floor, so that he struck upon his abdomen.

He immediately experienced a severe pain across the back, and vomited. He was, however, able to walk home, a short distance away. On reaching home the pain became abdominal and was very severe. There was persistent vomiting and obstipation. Fifteen hours after the injury he was admitted to the Roosevelt Hospital, with all the signs of a diffuse peritonitis. His temperature was 101.6° F.; pulse, 112; respirations, 48.

Operation was performed two hours after admission, seventeen hours having elapsed since the injury.

A well-marked seropurulent general peritonitis was present. Twelve inches from the ileocolic junction the ileum was contused, and in the centre of the contusion there was an aperture five-sixteenths of an inch in diameter, from which the intestinal contents were exuding.

The area was inverted by means of Lembert stitches, the peritoneal cavity thoroughly washed out and closed, a short cigarette drain having been introduced, reaching barely into the peritoneal cavity. The wound was repaired by a tier suture. Infection occurred in some of the skin sutures, and on the ninth day the patient, who had developed bronchitis, burst the superficial part of the wound open in a fit of coughing; otherwise, convalescence was uneventful.

SPLENECTOMY.

Dr. John A. Hartwell presented a boy, aged twelve years, who was admitted to the Lincoln Hospital on March 1, 1905.

The history obtained was that he had fallen about fifteen feet, striking directly on his left side on a piece of timber. He suffered considerable local pain, but was able to walk home, where he was seen by a physician. On the following day he was so much better that the physician was notified not to call, but on the third day the doctor was again called because the boy complained of considerable pain in the abdomen, rather localized on the left side. It was aggravated by pressure and deep breathing. The boy had vomited once.

The patient's temperature on admission, forty-six hours after injury, was 100° F.; pulse, 88; respirations, 24. He was poorly nourished and somewhat anæmic. The respiration was thoracic in character. There was some abdominal distention, with generalized pain and rigidity, but more marked over the upper left quadrant. In the left lumbar region, at the costal margin, a mass was palpable. It was very tender. There was also pain on pressure over the lower four or five ribs. The child was most comfortable when lying on his back, with his legs drawn up. The leucocytosis was 20,000.

Operation.—An exploratory incision, two-and-a-half inches long, was made parallel with the outer border of the left rectus, beginning at the costal margin. The peritoneum was opened, and its cavity found to contain free blood. The wound was thereupon enlarged by a transverse incision outward, and the spleen brought into view. After removing the adherent omentum, a fracture of the spleen, penetrating one-third the organic thickness through the hilus, was found. The splenic vessels were caught in a single large clamp, and tied, and the spleen was then removed, leaving the clamp *in situ*. The abdominal cavity was repeatedly washed out with saline solution, and, as the fluid continued to return blood-stained, a further examination was made, which revealed a rent in the posterior abdominal wall and a slight laceration of the left lobe of the liver. This was checked by packing with gauze. The wound was closed in the usual manner, leaving the clamp on the splenic vessels undisturbed.

When the clamp was removed on March 6, five days after the operation, there was no hæmorrhage. The patient's recovery was uneventful, with the exception of a slight phlebitis of the left femoral vein, which developed on March 30.

Dr. Hartwell said the following blood counts were of inter-

est in connection with the case. On March 3, two days after the operation, there were 3,720,000 red blood-cells, 27,000 white cells, and 90 per cent. hæmoglobin. Polynuclears, 85.5 per cent.; mononuclears, 9 per cent.; lymphocytes, 5 per cent.; basophiles, 0.5 per cent. On March 7, red cells, 4,400,000; hæmoglobin, 95 per cent.; white cells, 24,000; polynuclear, 92 per cent.; mononuclears, 4 per cent.; lymphocytes, 3 per cent.; eosinophiles, .5 per cent.; basophiles, .5 per cent. On March 16 there were 4,100,000 red blood-cells, 18,000 white cells, and 95 per cent. of hæmoglobin. Polynuclears, 82 per cent.; mononuclears, 12 per cent.; lymphocytes, 5.5 per cent.; eosinophiles, 0.5 per cent. On April 12 the red blood-cells numbered 5,244,000; the white cells, 24,000; hæmoglobin, 90 per cent; polynuclears, 62 per cent.; lymphocytes, 24 per cent.; mononuclears, 12 per cent.; eosinophiles, 1 per cent.; basophiles, 1 per cent.; no normoblasts nor poikilocytes were found. The red cells were normal in size, and well colored. The presence of suppuration in the wound around the clamp and drain probably had some effect on the leucocytosis, though this was 20,000 prior to operation.

In presenting this patient, Dr. Hartwell raised the query whether in a case of this kind, which was in such good condition at the end of forty-eight hours, it was better to operate as he had done, or treat the case expectantly, with the hope that the bleeding would cease spontaneously, as was recommended by some authorities?

Dr. Benjamin T. Tilton thought that in cases of suspected laceration or rupture of the spleen, it was advisable to make an exploratory incision, and act according to the condition met with. Unless the abdomen was opened, one could never tell how severe the injury was. He recalled one case where a man, after an abdominal injury, walked about for four days before he felt obliged to seek medical advice. He was immediately operated on, and the abdomen was found filled with blood, which was traced to a ruptured spleen. A splenectomy was done, but the outcome was fatal.

SPLENECTOMY FOR GUNSHOT WOUND OF SPLEEN.

Dr. L. W. Hotchkiss reported the case of a negress, twenty-one years old, who was admitted to the J. Hood Wright Hospital on April 3, 1905, shortly after being shot at close range by a

.32-caliber revolver. On admission, the patient was in moderate shock, and presented a small wound in the left anterior chest wall, near the cartilage of the tenth rib. On the same side, posteriorly, there was a hæmatoma: this was about three inches from the spine, at a point corresponding to the eleventh rib, and beneath it the bullet could be felt. Her condition on admission was so good that it was first thought the wound was not a penetrating one. About two hours later, the patient's only complaint was of pain near the site of the wound, and in the upper part of the abdomen. There was, however, well-marked spasm of the abdominal muscles, and tenderness over the upper left abdominal segment. The pulse was somewhat rapid. Percussion over the left chest was negative. An immediate operation was advised and performed.

A vertical incision was made over the site of the wound and extended downward through the outer fibres of the left rectus muscle to the level of the umbilicus, and the peritoneum opened. The track of the ball passed backward between the cartilages of the ninth and tenth ribs, through the diaphragm, thence in and out of the anterior wall of the transverse colon, wounding the tail of the pancreas, then passing through the spleen and out through the diaphragm posteriorly, fracturing the eleventh rib. The bullet finally lodged in the soft parts about this rib, and was not altered in shape.

As soon as the peritoneum was opened, free blood and clots escaped, but there seemed to be no fresh hæmorrhage. A rapid search was made of the various abdominal viscera, and two bullet holes were found on the anterior free surface of the transverse colon, about three inches apart, and fairly well sealed by the prolapsed mucosa. These were closed by purse-string sutures, fortified by an overlying Lembert stitch. Several large clots were washed out of the splenic pouch of peritoneum, and on examination of the spleen, which was readily pulled up through the wound, it was found to be perforated from within outward by the bullet, which had passed through from a point on the antero-internal surface, just in front of the hilum and about the middle of the organ, to the middle of the external surface, and thence through the diaphragm,. fracturing the eleventh rib. The bullet could be felt through the hole in the diaphragm lying with fragments of the fractured rib beneath the skin. There was no wound of the

small intestines, but the tail of the pancreas was partially shot through transversely, and there was some oozing from that organ. After ligating the gastrosplenic omentum, the spleen was removed, and it was thought best to close the anterior wound and drain posteriorly this wound in the pancreas. Accordingly, an incision was made over the fractured rib behind, and its fragments were removed, together with the bullet. Through the hole in the diaphragm the packing of gauze in the pancreatic wound was led out, the wound being enlarged downward through the diaphragm for this purpose. As the pleural cavity was opened, the upper end of the diaphragmatic wound was closed, and an attempt made to exclude the pleura from the abdominal drainage opening by suturing the diaphragm to the parietal pleura and packing it with a separate string of gauze. The patient was infused with hot saline solution during the operation, and left the table in fair condition. On the following day the patient's condition seemed somewhat improved, though the respirations were very rapid and the embarrassment of respiration painfully evident. Water was taken by mouth, and there was no vomiting.

On April 4, on account of the oozing, the outer dressings had to be changed. The abdominal packing and the wick to the site of the pleural opening were withdrawn, and replaced by small drainage strips of gauze. There was free oozing of bloody serum into the dressings.

On the following day, the patient's temperature was higher. There was free oozing into the dressings, which had to be changed twice daily. There was considerable odor to the discharge from the site of the pancreatic wound, and the gauze was stained with a light, brownish, foul-smelling fluid.

On April 6, œdema of the lung developed and the patient died. The autopsy showed that the left lung was completely collapsed, and the left pleural cavity partly filled with blood-stained serum. The peritoneal cavity also showed some sero-sanguinous fluid in the pelvis, and in the lesser sac, about the pancreas, some yellowish, foul fluid was found. There was no extending peritonitis, and no other wounds of the intestine or other viscera were found.

RUPTURE OF SPLEEN.

Dr. Hotchkiss showed a spleen which had been removed at operation about a week before. This was the third splenectomy

that had been under the speaker's care since February of the present year; two of them had occurred within one week.

The patient was a male, twenty-three years old, who was admitted to the J. Hood Wright Hospital on April 5, 1905, with the history of having fallen with a section of concrete flooring through four stories of a building on which he was at work, striking against various beams and obstructions in his descent. When first seen by the ambulance surgeon, he did not seem to be much injured, and declined to go to the hospital, but was finally persuaded to do so. Shortly after reaching the hospital he began to complain of severe abdominal pain, and when seen by Dr. Hotchkiss, shortly afterwards, he was drawn up in bed and complaining of intense pain. He had not vomited. Bloody urine had been withdrawn from his bladder by catheter. The abdominal rigidity was well marked, and the abdomen was quite tender, especially over the left side. A diagnosis of probable rupture of a solid abdominal viscus, with resulting internal hæmorrhage, was made, and, as the patient was in a condition of shock, and the rigidity of his abdominal muscles was suggestive of serious internal damage, an immediate operation was decided on, and performed about two hours after the accident.

Operation.—Under gas and ether anæsthesia, a left median incision was made through the fibres of the rectus. When the peritoneum was opened, dark blood in large amounts poured out. Immediate search was made for the spleen, but as the organ was large and its lower two-thirds uninjured, the damage to it was not at first clearly made out. As the blood welled up from the pelvis, the incision was extended downward and the bladder and kidney palpated. As no gross rupture of these organs could be made out, the spleen was re-examined and found to be completely ruptured at a point above its middle. There was a loose middle fragment which came away with the hand, and an upper fragment consisting of the upper pole of the organ, which was attached by some adhesions to the diaphragm. There was also a small loose piece which was washed out of the pelvis by the stream of saline solution.

The remains of the organ, consisting of the lower two-thirds, was pulled into the wound, its omentum ligated, and easily removed. The upper fragment was peeled off the diaphragm and also removed. The left kidney was again carefully palpated

and did not seem to be ruptured. As no further injuries were found, the abdominal wound was closed after partly filling the cavity with warm saline solution. Patient returned to bed in rather extreme shock, from which he soon rallied.

The course of convalescence ran smoothly enough until the seventh day, with the exception of a cough, when on account of tension the sutures were removed. The day following, the wound was found to have reopened and some intestine and omentum to be protruding. He was taken to the operating room, etherized, and the prolapsed intestine and omentum returned and the wound tightly sutured. It was found at this operation that the adhesions between some of the coils of gut were of considerable extent, and the freeing of these coils necessarily left several areas denuded of peritoneum, which areas were covered as far as possible with Cargile membrane, although some of the latter became displaced when the intestines were returned.

Five days later the patient developed signs of acute and complete intestinal obstruction, for which operation was promptly done April 17. The acute angulation of adherent loops of small gut was found responsible for the condition, and these bands and adhesions were divided as speedily as possible; but the patient succumbed to the shock of operation and died about two hours later.

Dr. Lilienthal said that in one case of rupture of the spleen that had come under his observation, he temporarily checked the hæmorrhage by packing the wound with gauze, but the patient died. He thought Dr. Hartwell acted rightly in removing the spleen in the case he showed, as it was impossible to accurately determine the nature of the injury without loosening the adherent omentum, and having once done that, and encountered bleeding, nothing remained but to remove the spleen.

Dr. Erdmann said that about a year ago he saw a child under five years old with a transverse rupture of the spleen, near the hilum. He closed the rupture by putting in four sutures, and the child recovered. In another case seen one month previous to that in the service of Dr. J. E. Kelly, in which there was multiple laceration and fragmentation of the spleen, the organ was removed and the child recovered.

Dr. Blake said he had obtained good results in treating these cases by packing the wound and leaving the spleen. He

did not think it was necessary in all cases to remove the organ. In certain cases, however, where the rupture was near the hilum, efficient pressure was impossible, and under those conditions removal of the spleen was advisable.

Dr. George Woolsey said that about eighteen months ago he saw a case of hæmorrhage of the spleen following injury. The patient was an Italian, who gave a history of malaria. The spleen was enlarged and somewhat adherent, and, as the bleeding could not be satisfactorily controlled by packing, the organ was removed. The patient died. Packing of the ruptured spleen seemed to the speaker to be a difficult matter, unless it were possible to retain the packing by temporary catgut sutures.

FRONTAL SINUS SUPPURATION.

Dr. Robert H. M. Dawbarn presented a man of fifty years of age who was brought to him by Dr. J. A. Hays, of New York City, with a history of having suffered from this disease for at least five years.

Operation.—The eyebrow was shaved and split along the orbital edge as far out as the supraorbital vessels and nerve. The more usual vertical skin-incision up the forehead, leaving a very perceptible scar, seems quite unnecessary. Next, the cavity was freely exposed by use of a coarse dental drill followed by a rongeur; this opening being just below, instead of involving, the orbital edge, to prevent a subsequent sinking in of the eyebrow. Next, instead of the customary passage, by force, of a forceps, somewhat along the infundibulum, crushing delicate bones to make room for a rubber drainage-tube, Dr. Dawbarn used the plan which he originated many years ago, which is illustrated by a wood-cut in Dr. George R. Fowler's article upon "Frontal Sinus Disease" in Wood's Reference Hand-Book; namely, by a peculiar bending of a probe it is passed without any force down the infundibulum and out at the nostril. This can with practice almost always be accomplished, although occasionally it may require a few minutes' manipulation, and slight modification of the shape given the probe. (Filling the infundibulum beforehand for a few minutes with dilute adrenalin chloride and cocaine solution, by greatly overcoming congestive obstruction due to the inflamed mucous membrane, facilitates this step, of course.)

A stout thread is next tied behind the knob of the probe, and drawn through; and, finally, by the aid of this thread a piece of soft rubber catheter, well fenestrated, is drawn down into place for effectual drainage.

After the discharge has almost ceased, the upper end of this tube is shortened well down, and the split eyebrow freshened and united. Finally, perhaps a fortnight later, the remainder of the tube is withdrawn through the nostril.

Attempts to convey drainage from below upward through the infundibulum are rarely successful; and a fatal case, due to piercing the brain through softened bone while using a stiff instrument in such an endeavor, is recorded in several text-books.

MALPOSITION OF THE APPENDIX AS A CAUSE OF FUNCTIONAL DISTURBANCES OF THE INTESTINE.

Dr. Joseph A. Blake read a paper with the above title, for which see page 394.

Dr. Willy Meyer said his experience had convinced him that malposition or kinking of an uninflamed appendix was not of rare occurrence. He could recall a number of cases where the symptoms pointed to appendicular trouble, and where the patients were entirely relieved by removing a seemingly normal appendix with a short meso-appendix. The symptoms this condition gave rise to were apparently of a reflex character. Such patients frequently complained of more or less continuous pain, sometimes mild, at other times severe, but did not have a frank attack of appendicitis. In some instances, the speaker said, he had been led to suspect this condition, and he had expressed the opinion to the patients that there was something wrong in the anatomical condition of the appendix. He could recall cases where he found nothing but peri-appendicular adhesions to the cæcum, which were easily peeled off. The reflex symptoms in these cases were sometimes referred to the epigastrium, and were often very vague in character.

Dr. John B. Walker said that in operating on interval cases of appendicitis, it was not uncommon to find the appendix in a malposition. In a case seen only a few days ago the patient was a woman of thirty years, who gave a history of three previous attacks of appendicitis. There was abdominal tenderness, more or less generalization, with slight distention. The leuco-

cyte count was 25,000. The usual incision for appendicitis was made, but the appendix could not at first be located, it not being in the normal region. Further investigation with the finger disclosed the tip of the appendix very high up, at a level with the lower pole of the right kidney. A second incision was made at the outer border of the right rectus from the edge of the ribs downward. The appendix was gangrenous and was removed. Both wounds healed per primam.

Dr. Woolsey said that in one of the type of cases mentioned by Dr. Blake he thought the malposition of the organ was often due to adhesions from previous inflammation and not from congenital causes. He recalled a number of cases of malposition from adhesion, where he found the adherent appendix well up behind the cæcum and colon, dragging the cæcum itself out of position. About ten days ago he had operated on a member of the house staff of a hospital, and in that instance he found the appendix high up behind the ascending colon, and dragging the cæcum up and back. The history of these patients was not always typical of appendicitis; the classical signs of the disease were not all present, but removal of the organ seemed to effect a cure of the intestinal disturbance and of the local pain and tenderness.

Dr. Dawbarn said the differential diagnosis between appendicitis on the one hand and right ovarian or tubal inflammation on the other hand was sometimes a difficult matter, and in examining such patients, the speaker said he had come to lay stress upon the following point: When, with the finger in the rectum, the tenderness was found towards the back of the rectum, it was due to inflammation of the appendix rather than of the ovary or tube,—the appendix in about one-fourth of the cases entering the pelvis,—whereas, if it (the tenderness) was in *front* of the rectum, it was due to the latter and not to the appendix. The rule was not infallible, but very helpful.

Dr. Lilienthal said he had seen several cases in which constipation was a symptom of malposition of the appendix, and in which the constipation was entirely relieved after removal of the appendix for chronic inflammation. In one instance the appendix was up behind the outer side of the colon, and was not really inflamed, nor apparently had it been. In another case there had been one severe attack of appendicitis, from which the patient had entirely recovered. In both instances the constipation

was relieved by removal of the appendix. The explanation offered for the constipation in these cases was that the adhesions caused inhibition of the peristaltic action of the bowels.

Dr. Blake, in closing, said that in some of these cases there was constipation, in others diarrhœa and fermentation. The complex of symptoms was hard to unravel at times. He thought it was reasonable that these symptoms were the result of a short meso-appendix. The cæcum, constantly tugging on the appendix and meso-appendix, might give rise to pain and discomfort, and it was perfectly rational to accept the theory that by remedying this condition we might relieve the symptoms.

INTUSSUSCEPTION OF SMALL INTESTINE.

Dr. Benjamin T. Tilton presented a specimen removed from a child of nine months who forty-eight hours before admission began to show symptoms of intestinal obstruction, with the passage of blood per rectum. Examination showed very slight abdominal distention and rigidity, with some tenderness. High up on the right side, below the free border of the ribs, a small tumor could be distinctly mapped out. The child's general condition was poor. The pulse was feeble and rapid; temperature, 102° F.

An incision was made over the swelling, and the tumor exposed. It was found to involve the small intestine high up, and it was so movable that it was easily delivered through a small abdominal incision. It was found to consist of an invagination of the gut; as it was impossible to reduce it, a rapid resection was done, and the cut ends united with a small Murphy button. There was considerable shock, and the child survived about eight hours.

Dr. Tilton said the specimen seemed worthy of presentation on account of the rarity of intussusception confined to the small intestine.

Dr. Erdmann said he had never seen a recovery after resection of the gut in a child under one year of age, nor had he ever seen a case, although having now his thirty-first case, in which the small intestine alone was involved, as in the specimen shown by Dr. Tilton.

REVIEWS OF BOOKS.

OPERATIVE SURGERY. By DR. JOSEPH D. BRYANT, Professor of Surgery at Bellevue University Medical College, New York City. Fourth Edition. D. Appleton & Co., 1905.

That four editions of this well-known work should have been called for at intervals relatively short is an indication of the estimation in which it is held by the profession, and also evidence that the distinguished author is determined that the operative surgery which bears his name shall be the last word on the subject, so far as this is possible in an age of rapid change and constant improvement. This edition has been thoroughly rewritten, and has been printed from new plates. It contains about 250 more pages than the previous edition and 200 more illustrations. It is the most complete work on operative surgery which has yet come under the notice of the reviewer. In the introductory chapter of the first volume the author generalizes broadly and lays down a number of maxims, and makes many commentaries which are worth the most careful consideration of the young surgeon, nor will the older operator lose anything by an occasional review of this chapter. In these days of commercial, not to say bargain counter, surgery, men whose rashness and desire for the rewards of the surgeon outpace their knowledge and capacity may well ponder over the following observation of Dr. Bryant: "An understanding of the anatomy of the parts involved in the operation is always essential to the comfort of the operator and frequently to the safety of the patient." The first part of this commentary we fear is superfluous, since the man who operates from the commercial stand-point is not apt to be troubled about his own ignorance. Indeed, even the safety of the patient will

concern him only in so far as it may affect future fees. The author further says that this knowledge is somewhat difficult to acquire and always of uncertain tenure. This is a good text for a sermon on the necessity of a long apprenticeship in the demonstratorship of anatomy as a prerequisite to real surgical attainments. We believe that it would be difficult to point out any of the surgeons of the first rank in this country who have not served such an apprenticeship. One may epitomize Dr. Bryant's remarks on this subject rather bluntly as follows: "Better learn your anatomy before you try to operate. You cannot learn it out of a book. Learn from the cadaver." This does not sound as smoothly as Dr. Bryant's flowing sentences, nor does it drop trippingly from the tongue, but it is what the author means, nevertheless.

The most important additions to the first volume occur in the chapter devoted to intracranial neurectomy, which contains an account of every operation for the relief of trigeminal neuralgia which has ever been suggested. Matas's new procedure for aneurism is well described, so is Cushing's operation for nerve grafting for the relief of facial paralysis. The description of the operations on the mastoid antrum has been elaborated, and some new procedures and instruments concerned in the surgery of the œsophagus are minutely described. It is with some surprise that we search in vain in the article on plastic surgery for any mention of Brophy's methods in cleft palate. The second volume contains many new operations on the intestinal tract. Indeed, there is not a single operation which has been omitted. All the various devices for facilitating intestinal anastomosis are here illustrated. There is not a stitch which has ever been invented which is not illustrated in these pages. McGraw's recent method of colectomy, Moynihan's gastro-enterostomy, Mayo's pylorectomy, and Finney's pyloroplasty are all clearly described. The section on the surgery of the kidney describes the investigations of Broedel and Kelly on the arterial supply of this viscus and its relation to nephrolithotomy. There is much new matter in the

article on hernia, besides clear descriptions of all the standard operations for the relief of this infirmity. The article on the surgery of the prostate contains a lucid description of all the recent work that has been done in this important branch of surgery. There is not an operation of moment which has been omitted in any branch of surgery, except those which the author has specifically omitted, namely, operations of the female pelvis and the surgery of the eye. The descriptions and illustrations throughout are so clear that it is impossible to misunderstand them. Nevertheless, let the tyro be not deceived. Let him take Dr. Bryant's advice and learn his anatomy in the dissecting-room. At the same time, if he will not or cannot do this, there is no book which will keep him out of trouble so far as a book can do so like this work of Dr. Bryant.

ALGERNON THOMAS BRISTOW.

THE URINE AND FÆCES IN DIAGNOSIS. By OTTO HENSEL, Ph.G., M.D., Bacteriologist, German Hospital, New York, and RICHARD WEIL, A.M., M.D., Pathologist, German Hospital, New York, in collaboration with SMITH ELY JELLIFFE, M.D., Ph.D., Instructor in Pharmacology and Therapeutics, Columbia University; Visiting Neurologist, City Hospital, New York. Illustrated with 116 Engravings and 10 Colored Plates. Philadelphia and New York: Lea Brothers & Co., 1905.

Numerous as are the works on urinalysis, this volume has much to recommend it over its predecessors, for it is replete in all the modern methods which have contributed towards making the analysis of urine a most exacting study, demanding rather more than the reagents for albumen and sugar and a microscope.

A very commendable feature is that the urine is studied not merely from the laboratory stand-point, but the findings of the analysis are everywhere harmonized with the clinical picture. By far the greater attention has been given to the chemical analy-

sis of the urine; whereas the microscopic examination of the cellular elements found in a pathological specimen of urine and the bacteriology are in for a brief consideration. A very signal service has been rendered by the decided manner in which it is once more stated that a microscopic examination of the cellular elements is no ear-mark of the location of the disease in the kidney, pelves, ureter, or bladder.

In regard to tubercle bacilli, insufficient stress has been laid upon the need of repeated search for these in a urine in which they are suspected, and the teaching that urine injected into the abdomen of a guinea-pig will, if it react, contain tubercle bacilli, is not precise, since that animal must first be proven healthy by a previous injection of tuberculin, and then the urine must not be overladen with pus organisms, for, if these predominate, the animal will succumb to septic poisoning.

There is no gainsaying that staining gonococci with methylene blue or Jenness stain is easiest, but it certainly is not paramount to the Gram stain, which latter, as given in a modified form, tends to confusion.

The remainder of the work is devoted to an examination of the fæces, a hitherto unexplored field. As stated in the preface, this share of the work is a compilation of scattered writings, but largely made possible by a perusal of the monograph of the German investigators, Schmidt and Strassburger.

MARTIN W. WARE.

ACUTE CONTAGIOUS DISEASES. By WILLIAM M. WELCH, M.D., and JAY F. SCHAMBERG, A.B., M.D., Philadelphia. Pp. 781. Fully illustrated. Philadelphia and New York: Lea Brothers & Co, 1905.

The present volume is the result of observations made at the Municipal Hospital of Philadelphia during the past thirty-five years, among which are the records of 9000 cases of smallpox, a similar number of scarlet fever, and 10,000 of diphtheria. A

text of 642 pages is used in the discussion of these three diseases alone.

The history of each disease has been carefully reviewed by the authors, and forms the introduction of each contribution. Among the diseases treated other than the above are chicken-pox, measles, rubella, and typhus fever.

The subject-matter is comprehensive, easily readable, and not confused. The treatment of the many complications of each disease is gone into in detail, and will prove especially welcome to the general practitioner.

The illustrations are profuse and very commendable, in several instances series of photographs show the successive stages of the various diseases, and also those with which they might be confounded,

JAMES TAFT PILCHER.

UNTERSUCHUNGEN UEBER KNOCHEN ARTERIEN mittelst Röntgen Aufnahmen injizierter Knochen und ihre Bedeutung für einzelne pathologische Vorgänge am Knochensysteme. Von Prof. Dr. E. LEXER und Dr. KULIGER und Dr. WOLFG. TURK, Volontär-Assistenten der Königlichen Chirurgischen Universitat's Klinik Sr. Excellenz. von Bergmann, Berlin, Mit 22 Stereoscopischen Bilder, u. 3 Tafeln. Berlin: August Hirschwald, 1904.

The funds of Countess Bose were used to defray the expenses of the costly experiments, the valuable results of which are presented us in this monograph.

The blood was first washed out of the bones by the injection of physiological salt solution into the carotids, and this followed up by the injection of mercury rubbed up with turpentine. In adults the injections were made successively into the main artery of each extremity. The injection of the plexus of the blood-vessels of the periosteum and joint capsules was so dense in the radiographs taken as to obscure the arrangement of blood-vessels in

the interior of the bone. All radiographs were taken from bones stripped of periosteum and capsule. The bones of young infants and children were best adapted to show in radiographs that there are three areas of vascularization,—the zone of the diaphysis, that of the epiphysis, and that of the metaphysis.

Then follows a detailed account of the distribution of these vessels in the long and short bones, illustrated in twenty-two stereoscopic radiographs printed on diaphanous paper so as to permit their being viewed in an American stereoscope.

Two concluding paragraphs show to what extent the localization of disease in distinct foci of bone is due solely to embolism, or rather the mechanical conditions of the arterial system.

Senile changes of bones are also to be explained by such retrograde changes that affect the blood-vessels of the diaphysis, so that greater vascularity is peculiar to the epiphyses. We have therefore in old age, as well as infancy, greater vascularity as potent factors of disease.

This research is limited to physiological conditions of the bone; there yet remains to investigate with the X-rays pathological specimens of bone injected with mercury. One such radiograph of a sarcoma of the shoulder is added.

MARTIN W. WARE.

TO CONTRIBUTORS AND SUBSCRIBERS.

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